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THE DROUGHT OF 1979-1980 AT THE KEOLADEO GHANA SANCTUARY, BHARATPUR, RAJASTHAN[1]

Stanley & Belinda Breeden[2]

(*With six plates, a map and a text-figure*)

Introduction

Between November 1st 1979 and November 13th 1980 we spent 181 days in the Keoladeo Ghana Sanctuary[3]. The Sanctuary is near Bharatpur in eastern Rajasthan and is also referred to as Bharatpur Sanctuary, or simply Bharatpur, in these pages.

During our year there we were in the Sanctuary for part of every month. Our purpose was to make a film depicting the wildlife through the seasons. This activity did not allow us to make as detailed observations as we would have liked. However, given Bharatpur's extraordinary interest and the paucity of published material on it, we thought it worthwhile to put our observations on record. The only papers we could find that dealt specifically with the Sanctuary are by Ali (1953) and Saxena (1975). There is also a bird list by Abdulali and Panday (1978).

Our stay in the Sanctuary coincided with a season of unusual drought as the monsoon rains of 1979 were well below average (see table no. 1). We were also able to witness the regeneration of the plants and animals after the heavy monsoon rains that fell between June and September 1980.

Every day that we were in Bharatpur we kept extensive notes and the following records are drawn from these notes. Most of the observations of nesting birds were made from blinds. For observations on the birds nesting in the two breeding colonies and a few others we used a blind constructed on the top of an aluminium tower that could be raised to a height of up to 7 metres. This blind, because of its light weight, could easily be moved from one place to another and was readily accepted by the birds.

There is one word that recurs throughout

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[1] Accepted December 1981.

[2] 57 Tahiti Avenue, Palm Beach, Queensland, Australia 4221. *Indian address*: Mokshpuri Farm, Rajokri Marg, New Delhi 110 038.

[3] In 1981 the Sanctuary was declared a National Park and renamed Keoladeo National Park.

this account that could cause confusion. This is the word *bund*. It can mean both an impounded marsh or body of water as well as the actual dike or dam, that retains the water. We have written the word as Bund when it refers to a marsh or lake, e.g. Ram Bund or Cirra Bund. When it refers to a dike or dam we have written it as bund.

THE SANCTUARY

The Sanctuary is essentially an area of semi-arid scrubland, in which, through the aid of a series of canals, sluices and bunds, water is impounded to form extensive marshes. The marshes are sub-divided by a series of tree-lined bunds. The Sanctuary is 29 km^2 in size.

In a normal season water is fed into these marshes twice a year from Ajan Bund which is located just outside the Sanctuary on its southern side. The first time water is let in is shortly after the onset of the monsoon when enough water from the Gambhir and Banganga Rivers has accumulated in the Bund. This is usually in mid-July, depending on the onset of the monsoon. In 1980 water was let in on July 15th after heavy rain during the second week of that month. Virtually the entire Sanctuary was flooded. The second time water from Ajan Bund enters the Sanctuary is in late September or in October when the Bund is drained ready for the winter cultivation. In 1980 the second allotment of water, which in effect tops up the marshes, was let in on September 29th. Again nearly the whole Sanctuary was flooded.

This system of marshes was first constructed by the then Maharaja of Bharatpur in the 1850's. The refinements of canals, sluice-gates and roads on tree-lined bunds were added in the 1920's or 1930's by the present Maharaja of Bharatpur, now known as Col. Sawai Brijendra Singh. The purpose of creating these marshes was to improve the duck shooting for the Maharaja and his guests. During this time protection was rigidly enforced and big shoots limited to two or three per season. Royalty and other important persons from around the world shot ducks in Bharatpur in those days. Large numbers of storks, ibises, herons, egrets, cormorants and darters were also attracted to Bharatpur. These birds came during the monsoon months when they nested.

In 1956 the Rajasthan Government took control of the area and it became the Keoladeo Ghana Bird Sanctuary. The Maharaja retained shooting rights until 1972. The last big shoot was held in 1964.

Apart from the marshes, whose area varies according to the time of year, there are extensive tracts of dry land. The vegetation of these dry lands grades from true tall forest, through open woodland, dry scrub and savannah to bare areas of saline soil sparsely dotted with shrubs.

The forest areas, which are small pockets mostly in the NE section of the Sanctuary, are dominated by kalams or kadams (*Mitragyna parvifolia*), jamuns (*Syzygium cuminii*), babul (*Acacia nilotica*) and an occasional neem (*Azadirachta indica*) which was probably introduced. The open woodland is mostly babul with a small proportion of kandi (*Prosopis spicigera*) and ber (*Zizyphus mauritiana*). The scrublands are dominated by ber and kair (*Capparis decidua*). Piloo (*Salvadora oleoides* and *S. persica*) also occur in the scrubland and are virtually the only woody plants that grow in the areas of saline soil. Saxena (1975) gives a list of plants for Bharatpur. The topography of the Sanctuary is almost uniformly flat.

The Bharatpur Sanctuary has, for its size, an amazing variety of species of birds. To date just over 350 species have been recorded there and nearly every year new ones are added to the list. Not only are there many species, but at most times of the year there are vast numbers of birds. The volume and diversity of bird life may be ascribed to several factors. Firstly it is a haven for migratory birds in winter. Secondly, large numbers of birds are attracted to Bharatpur to breed during the monsoon. A third factor is the diversity of habitat, from dense forest to savannah in the dry land areas and from open water to mudflats in the wetlands, all of which support a large population of resident as well as migratory birds. The fourth reason may well be that Bharatpur is the last substantial area of more or less natural, though not undisturbed, habitat in a vast area of the Gangetic plain—an area that once had uncountable numbers of birds (Hume 1881). The birds have become concentrated in this last remnant.

TABLE 1

RAINFALL FIGURES FOR AGRA DISTRICT

(*Figures in millimetres*)

	1979	1980	Average Rainfall for thirty years 1931—1960
January	12.2	0.0	13.2
February	46.7	4.6	13.5
March	4.8	23.0	8.4
April	2.2	0.3	6.6
May	34.4	9.5	9.1
June	17.5	72.4	51.8
July	133.6	249.3	195.6
August	31.1	290.8	218.2
September	7.2	11.0	133.9
October	4.6	22.0	19.6
November	7.1	1.0	3.3
December	3.0	19.3	5.8
Total	304.4	703.2	679.0

DROUGHT IN 1979

The average annual rainfall for Bharatpur is 662 mm (Saxena 1975). No figures were available for Bharatpur for the years 1979 and 1980. The nearest centre for which reliable rainfall data was available was Agra which is 50 km away by road. The annual average for Agra is 679 mm. There are no topographical or other features that would make the rainfall between the two places significantly different. The figures show that in 1979 Agra (and by inference Bharatpur) received considerably less than half its normal rainfall while in 1980 the rainfall was above average. The rainfall figures for Agra are summarised in Table 1.

The rain that fell during July and August 1979 was not sufficient to fill Ajan Bund and only a small amount of water was let into Bharatpur's marshes during August (Abrar Khan, pers. comm.). No further water was released from Ajan Bund in 1979. The marshes were by no means filled and by November there were only a few gutters of water at Ram Bund, the NW corner of Rauji Bund 1, some water at Sapan Mori and a small area of water on the northern end of Hans Sarovar Bund. The canal between Keoladeo and Sapan Mori was partially filled and Cirra Bund's western half had shallow water in it. Over the months these dried further and further until by March water remained only in the areas where it was pumped from four different bores. The rest was completely dry.

WATER PUMPED FROM BORES

The Rajasthan Forest Department pumped water from four bores (marked bores A, B, C and D on the map) into various parts of the marshes in an effort to maintain water in the Sanctuary. Pumping began in November and December. Pumps B & C were in time discontinued but Pumps A & D worked continuously, when electric power was available, until the beginning of the monsoon. Pump A eventually almost filled Ram Bund and Pump D maintained water in a small portion in the extreme southern part of Cirra Bund. Unfortunately the water from Pump D was not used to maximum effect to safeguard the Siberian Crane during a difficult winter (see under Siberian Crane below).

The primary importance of these flooded areas was to effectively maintain a breeding nucleus of turtles, aquatic snakes, frogs, fish and aquatic invertebrates. All, except the turtles and snakes, are of paramount importance as food species for the large numbers of birds that congregate in the marshes. Migratory and resident birds also benefited greatly from this water (see bird list below).

EFFECTS OF THE 1979 DROUGHT

(1) *Monsoon Nesting Birds*

As in normal years darters, cormorants, egrets, herons and Openbill Storks congregated in the Sanctuary during the latter half of June. Egrets and Openbill Storks began nest-building and some eggs were laid. But when no substantial rains arrived and the marshes were not filled with water from Ajan Bund during July, the birds, abandoned their nests. A few spoonbills and Painted Storks arrived but neither of these species attempted to nest (Abrar Khan, pers. comm.). By September 9th when we visited the Sanctuary the heronries were completely deserted and only a few individuals of the species that normally nest in thousands, were present.

(2) *Migratory & Nomadic Birds in Winter*

The normal complement of ducks that come to Bharatpur in winter were absent. Small numbers of most species were present in November and December, but by mid-January most had left. Only the Ruddy Shelduck stayed in the areas of pumped water, some staying right up to the breaking of the monsoon. Greylag Geese, present in hundreds and at times thousands during normal winters, came in only very small numbers during the drought winter. Largest numbers occurred during the autumn and spring migrations. During the first week of March 1980 about 80 of these geese stayed in Ram Bund. Barheaded Geese, by contrast, were present throughout the winter, their numbers fluctuating between 500 and 1200. This species fed, from November till the time they left in mid-March, on the new growth of grass in Ram Bund and the eastern part of Cirra Bund. The new growth was stimulated by water pumped into these places.

During January and early February when the last water was drying up in the canal, in the southern area of Cirra Bund and the northern portion of Hans Sarovar Bund, large numbers of birds gathered there to eat fish, some of them very large, that were concentrated in the shallow water. Only the larger birds, cranes, storks, Grey Herons and pelicans, could catch these fish. The smaller fish, which could have been caught by darters, cormorants and egrets seemed to have disappeared already. The most spectacular invasion of birds that came to catch these large fish were the White Pelicans. During the second half of January about 450 of them were fishing the shallows (for details see the bird list below).

In a normal season the marshes are choked with grasses, sedges and other aquatic vegetation. In the winter of 1979-1980 this vegetation had died back, even before the water had completely dried up. The altered conditions allowed for the invasion of pelicans, which would not be able to fish in areas of dense vegetation. Another change was that there were extensive areas of mud, particularly in Cirra Bund, which attracted large numbers of wading birds such as plovers, sandpipers, godwits, etc. Again this is a group of birds normally scarce in the Sanctuary itself.

The Common Shelduck, and a small number of avocets (never exceeding 12)—rare birds for Bharatpur—were present on the Cirra Bund mudflats till the end of February. The mudflats were favoured by unusually large numbers of roosting Sarus Cranes.

Large fish, left stranded by the receding water and the White Pelicans, were eaten mostly by Spotted Eagles, Ringtailed Fishing Eagles, Marsh Harriers, Black Kites, House Crows, Jungle Crows, Crow-Pheasants, and Whitebreasted Waterhens. We never saw any kind of vulture feeding on the dead and dying fish.

The areas of pumped water were much favoured by Wagtails, especially the Yellow and Yellowheaded on their northward migration during March and April and even during the first week of May.

(3) *Vegetation*

On the dry marshes all vestiges of vegetation disappeared once the water had dried up. The marshes became expanses of bare, cracked soil.

The woodlands were less severely affected. Herbs, grasses and herbaceous climbers had died back and in many places the soil was bare. But in other places, such as the Deer Park and the area south of the nursery, a good cover of grass remained.

Several trees such as the jamuns and capers actually flowered and put on new leaves. The two species of piloo had heavy crops of fruit during March and April which attracted numerous Rosy Starlings on migration. The babul and kadam, by contrast, dropped their leaves during the hot months and did not put on new growth until after the rains arrived. But this is the normal pattern, though the fruiting of the piloo seemed more profuse than usual.

(4) *Spring and Summer Nesting Birds*

General information on breeding seasons is from Ali & Ripley (1968-1974) unless otherwise stated.

For a number of species spring and summer breeding proceeded normally. These included Stone Curlew, Small Green Bee-eater, Hoopoe, Crimsonbreasted Barbet, Mahratta Woodpecker, Black Drongo, Jungle Babbler, Tailor Bird, Purple Sunbird and Yellowthroated Sparrows. Nests of these species were found at times and in numbers as they would in normal seasons.

Some species nested late, though not in noticeably lesser numbers. The Mottled Wood Owl's eggs hatched on the 29th and 30th of March in 1980. In 1981 they hatched in early February as they did in previous years (Abrar Khan, pers. comm.). Roseringed Parakeets were still courting and establishing nesting territories during the first week of March while normally this activity does not go much beyond January. Though the nesting of Green Pigeons is variable, the normal season is March-April. We found three nests of this species and all were completed in May. The nesting season for the Grey Partridge is given as March-September and sporadically in other months. In 1980 we found no nests and saw no young before October 10th. On that day we found two nests and subsequently we saw five pairs with very small chicks. In other years we have seen pairs of this species with small chicks in March and April. The Redwattled Lapwing's nesting season is given as March to September. We found nests, in both the dry areas and in places where water was pumped in, only in May and June. In normal years Indian Rollers nest in Bharatpur in some numbers during March and April (Abrar Khan, pers. comm.). In 1980 we found only one nest during those months, on April 15th.

We found three other nests in June. All had eggs which were subsequently inundated after heavy rains and abandoned.

The Sarus Crane and Spotbill Duck which we have seen nesting in March in seasons following good monsoon rains, were seen nesting only in August and September in 1980, i.e. after the monsoon rains. We found seven nests of Sarus Cranes and two of the Spotbill Duck. Some species normally nesting commonly in the Sanctuary failed to nest at all as far as we were able to establish. The Small Blue Kingfisher was not seen in the Sanctuary between March and June, its normal breeding season. The Goldenbacked Woodpecker, which is a common bird, normally nests in March and April. In 1980 we saw two pairs drilling nest-holes during the second half of June. Both nest-holes were taken over by Brahminy Mynahs. No other nesting activity by these woodpeckers was noted in the Sanctuary. Another normally common nesting bird is the Whitebreasted Kingfisher. Only one pair was seen with fledgelings and this was at flooded Ram Bund on the 22nd of June. The same day two pairs of this species were busy excavating nest-tunnels at Cirra Bund next to the Keoladeo Temple. These nest-tunnels were subsequently flooded.

A pair of White-eared Bulbuls was seen building a nest on 9th of April 1980 and another pair was feeding young in the nest on May 6th. The normal nesting season for this species is given as March to September and "may be influenced by rainfall and consequent food supply". However no nesting activity by this species was noticed during or after the rains.

The Redvented Bulbul on the other hand nested only after the rains came. The first nest was found on 27th of June and the last in early October.

(5) *Turtles*

(i) **Lissemys punctatus**

From the first days we were in Bharatpur in November 1979 we noticed hundreds of these turtles wandering in apparent randomness throughout the Sanctuary. Going by the evidence of large numbers of empty shells, this movement away from the drying marshes must have been going on for some time. Every day we saw turtles wandering out in the open right till the end of May. The peak months were November, February and March. During December and January when it was cooler there were fewer turtles walking about and after March most of the pools had dried up and the wandering turtles were mainly seen around the areas of pumped water at Cirra Bund and Ram Bund. A large proportion of these turtles were killed and eaten by Scavenger Vultures. These birds turned the turtles on their backs and then, by inserting their sharp and narrow beaks under one of the flaps over the rear legs, would begin to eat the reptiles. Once killed, King Vultures, crows and Crow-Pheasants also ate the turtles—but only the Scavenger Vultures could get into the shell and so kill the reptiles. The dried marshes and open woodlands were littered with a thousand or more empty shells.

A great many of these turtles found refuge in the areas of pumped water, and a much smaller number found aestivating sites in the woodlands.

After heavy rain during the latter half of June formed puddles in the woodlands, the turtles emerged from their hiding places and their depleted ranks had to run the gauntlet of Scavenger Vultures once more. Of all the vertebrates, with the exception of the fish, this species of turtle was most severely affected by the drought.

(ii) **Trionyx gangeticus**

This species is strictly aquatic and was never seen wandering in the dry areas. We did not see a single one that had been killed. During a normal season this species is very unobtrusive, usually all that is seen of it is an occasional large head emerging from the water. On three occasions we saw one of these turtles grab a bird from beneath the surface of the water. The birds were a coot, a Little Cormorant and a female Common Teal.

We saw this turtle stranded by the drought for the first time on 30th March 1980. Two individuals were in the last mud left in the canal near Sapan Mori and another across the road in Cirra Bund. We carried the Cirra Bund individual to the water near the Keoladeo Temple. It's carapace measured 71 centimetres along the dorsal surface. This species is able to bury itself in soft mud with remarkable speed. In April these turtles frequently came out of the water and basked in the sun. About 30 individuals of varying sizes were seen around the pool in front of the Keoladeo Temple during this month.

In the same month we often saw them chasing each other in the water; some quite large specimens even jumped clear of the water. On April 2nd a pair appeared to be mating in the shallows. Because of the constant action and dirty water it was difficult to see exactly what was happening.

(iii) **Kachuga tectum**

We saw this species only in the pool in front of the Keoladeo Temple. Every day they could be seen basking on fallen logs. They appeared to be unaffected by the drought.

During March, April and May the Keoladeo pool was a crush of turtles with the above three species jostling for space on logs and a short, narrow bund.

(iv) **Hardella thurgi**

On April 2nd we noticed a different species of turtle wandering in the dry canal near the Keoladeo Temple. It most closely resembled *K. tectum,* but was larger and did not have the "saw" pattern on its carapace. It's carapace, measured 48 centimetres lengthwise and 43 centimetres across (along its dorsal surface). We photographed it from all angles and it was later identified by Romulus Whitaker. This was the only live specimen we saw of this species, though we did find a number of bleached carapaces in the dry lake bed just to the southwest of the Keoladeo Temple.

End of the drought and the 1980 monsoon

Since the middle of May birds that nest in Bharatpur's marshes during the monsoon had come in increasing numbers. First to arrive, and in breeding plumage, were Cattle Egrets and Pond Herons. They were first seen on 6th of May. As the time of the monsoon drew nearer more and more birds arrived, though there was no noticeable change in the weather. Even on June 15th there were dust storms sweeping across the dry and desolated marshes and woodlands. But by that time four species of egrets, Pond Herons, two species of jacanas, two species of cormorants, darters and Openbill Storks had flocked to the Sanctuary. Mostly they were in the areas of Ram Bund and Cirra Bund that had been filled with water by pumping. Spotbill Ducks, Cotton Teal and Comb Ducks had also arrived after a long absence. Spoonbills and Painted Storks were present in very small numbers and were not part of the early influx.

On June 21st the first rain fell. It was cool and humid. Egrets and Pond Herons were scattered across the dark, wet soil picking up insects and other invertebrates forced to the surface by the rain.

Pheasant-tailed Jaçanas were calling everywhere. The monsoon broke on June 27th with a heavy downpour. The woodlands flooded and small pools formed on the marshes. New green growth appeared within days. Turtles emerged from their aestivating places and were sitting in puddles formed in the woodlands. From the 27th of June onwards there was some rain nearly every day for several weeks (see table no. 1 for rainfall). Sunshine was brief and infrequent. The marshes began filling slowly but remained shallow until the second half of July when water was let in from Ajan Bund.

About a week before that date egrets, darters, cormorants and Openbill Storks had begun displaying and nest-building in the breeding colonies in Rauji Bund 1 and at Sapan Mori. The Openbill Storks were the first to complete nests, closely followed by egrets, cormorants and darters. The egrets did not, at first, include Cattle Egrets. They did not nest inside the Sanctuary until early August and then only in the Sapan Mori Colony. This species, however, was nesting at the Bharatpur Railway Station as early as 13th July. Spoonbills, Painted Storks and Large Cormorants did not arrive in numbers and begin nesting in the Sanctuary until the middle of August, by which time the marshes had completely filled.

By far the greatest change took place in the woodlands, particularly during June and July when nearly every day was overcast and rains were frequent and heavy. Trees and shrubs put on new leaf and many flowered. The ground was covered with fresh new grasses and a multitude of herbs sprang up. Many different kinds of vines grew quickly and wrapped themselves around the scrubby trees. Fungi of many different kinds appeared everywhere. Insects and other invertebrates, especially millipedes, proliferated. For a few months the Bharatpur woodlands looked more like sub-tropical forest than semi-arid scrubland. But in September once the rains became less frequent and there were long periods of hot sunshine, the herbs and vines began to die back and the fungi dried up.

The most dramatic development, however, was the re-appearance of fish. We first noticed small fishes, only a few centimetres long, on July 29th in most of the marshes. By the first week of September certain parts of the Sanctuary, such as the canal, the areas between Sapan Mori and Bakalaya and the northern parts of Rauji Bund 1, at times seemed almost solid with fingerling fish swimming close to the surface. Birds, mostly cormorants, darters and egrets, fed on these fishes in huge, milling flocks. How the fish could breed up on such a gigantic scale after the severe drought remains a mystery. Some fish, though comparatively few, remained in the areas where water was pumped. We also noticed that fingerling fish came in the water from Ajan Bund. But the River Gambhir and Banganga, which feed into Ajan Bund, were also completely dry (Abrar Khan, pers. comm.) though it is possible that a few, small pools remained. But it seemed hardly enough to account for the phenomenal resurgence of numbers. When Ajan Bund was drained in late September, fields between the Bund and the Sanctuary that had been flooded, were covered with small fish when the water receded. Fishermen took several tonnes of small fishes out of the patches of water that remained after the dam had been drained. Unfortunately we were unable to identify any of the fish.

MAMMALS

The following are our more interesting observations on Bharatpur mammals.

Felis viverrina

FISHING CAT

In March, when the last water in the canal at Sapan Mori was drying up, we saw one and sometimes two Fishing Cats there nearly every evening. Once the canal had dried we did not see any more Fishing Cats, before or after the monsoon.

Paradoxurus hermaphroditus

COMMON PALM CIVET

On 27th April 1980 we had a good view of this civet at night by the light of a strong torch, at Bakalaya.

Herpestes edwardsi

COMMON MONGOOSE

On 30th June we saw this mongoose with a newly caught, quite large water snake at Bakalaya. The snake had coiled itself around the mongoose's body in its struggle to escape.

Hyaena hyaena

STRIPED HYENA

At about 8.15 p.m. on July 14th we clearly saw a hyena on the main road just north of the Forest Lodge. This species had not been seen in the Sanctuary for some years.

Lutra perspicillata

SMOOTH INDIAN OTTER

On April 1st 1980 we saw a pair of these otters with three small young sunbathing on a raised mound in Ram Bund. The animals were lying on their backs in the burning midday sun.

BIRDS

The notes below are not meant to be an exhaustive list of the birds we observed in the Sanctuary. Rather they record species and incidents of interest with special reference to the 1979-1980 drought. New records for the Sanctuary are marked NR and new breeding records as NBR. To date only Saxena (1975) has recorded breeding species. Most of the new breeding records we noted are of birds that nest during the summer and monsoon and are quite obvious. It is just that few observers visit the Sanctuary at that time of the year. In the systematics and nomenclature we have followed Ali & Ripley (1968 to 1974).

Pelecanus onocrotalus

WHITE PELICAN

White Pelicans are not regular visitors to Bharatpur, and some years they do not arrive at all. Abdulali and Panday (1978) list this species as "occasional" and Saxena (1975) as "sporadic". The Spotbilled Pelican (*P. philippensis philippensis*) is a more regular visitor, but in small numbers. The jheels and marshes, while having an abundance of fish, do not suit the pelicans as the dense aquatic vegetation impedes their method of fishing. Because of the drought the aquatic vegetation had died back and the shrinking areas of water had concentrated the fish into a small number of pools.

24*th January* 1980. We arrived in Bharatpur after an absence of 7 days. White Pelicans had arrived on the 22nd (Abrar Khan, pers. comm.). We counted 114 of these pelicans roosting in a dry part of Cirra Bund.

25*th January.* The pelicans were fishing in a narrow ditch of water left along the bund itself, about 300 metres from the Keoladeo Temple. They fished in the typical fashion for pelicans, i.e. a semi-circle of the birds would drive the fish to one end of the pool, catch as many as they could and then reverse and drive the fish in the opposite direction. Some of the fish the pelicans caught were very large—we estimated the weight of the largest to be between 2 and 3 kilogrammes.

A pair of Blacknecked Storks tried to drive the pelicans away from the ditch. The storks had a large young with them which, although already changing to the iridescent plumage of the adult, still begged constantly for food; incessantly peeping and crouching while loosely flapping its wings. The storks, particularly the male (dk brown iris), would circle low over the flock of pelicans and stab down at them with his beak. The female stork (bright yellow iris) more often threatened by walking straight at the swimming pelicans, her neck low and beak snapping. The pelicans kept their distance and after an hour or so would fly off to roost. But they came back again and again.
26*th January*. In the morning the pelicans were fishing in the canal between Sapan Mori and the Keoladeo Temple. The water was very shallow and the pelicans half-swam, half-waded in some places. Some of the fish the birds caught were too large for them to swallow and they disgorged them. Many of these fish died and were seen floating in the water or cast up on the mud banks. The largest of these disgorged fish we found was a catfish measuring exactly 80 centimetres in length. Its sides were deeply scored by the pelicans' beaks. The dead and dying fish were eaten by Spotted Eagles, Ringtailed Fishing Eagles, Black Kites, House Crows, Jungle Crows, Crow-Pheasants and Whitebreasted Waterhens.

28*th January*. The number of White Pelicans had increased considerably in the last few days. They were very difficult to count as they constantly moved from one end of the canal to the other. We counted, as best we could, a minimum of 450.

At 20.30 hours the pelicans were fishing in the canal in bright moonlight. Their fishing time was limited during the day as the remaining water was near roads where the birds were disturbed from about 8.00 hours onwards every morning by passersby.
16*th February*. Returned to Bharatpur after an absence of 15 days. Only one White Pelican remained. Abrar Khan told us that the pelicans had left on 9th February, when the areas of water in the canal and in Cirra Bund had dried up. There were very few fish left.

Pelecanus philippensis crispus
DALMATION PELICAN

29*th January* 1980. Identified two Dalmation Pelicans in a flock of soaring White Pelicans.

Anhinga rufa
DARTER

18*th June* 1980. A flock of 57 Darters arrived, though the only significant water remaining was in Ram Bund.
11*th July*. Noticed first nests being built at Rauji Bund 1 breeding colony.
14*th August*. A tree with nests of Little Cormorants and darters at the Sapan Mori colony had fallen over and died. Most nests were destroyed, but one darter with medium-sized young managed to restructure its nest and keep it going. The nest was only a few centimetres above water level.
4*th September*. Two still downy white chicks in a darter's nest under observation begged incessantly. The parents when on the nest without further food for the young turned their heads away, resting them on their backs, to discourage food begging. When begging for food the young do so with beaks closed, ready to insert their beaks into those of their parents. Later in the day when it was hot, as early as 8.30 hours, the chicks begged with beaks wide open. When this occurred we saw the adult take off, fly a half-circle around the nest tree, land in some open water, dip its beak into the water (without diving) and return to the nest. It then gave copious supplies of water

to each chick by inserting its beak a short way into that of the young.

21st September. Young in nests in the Rauji Bund 1 breeding colony were now very large. Wings and tails were fully formed but backs and chests were still partially covered in down. Most young left the nest and clambered to the tops of the nest trees, their necks snaking above the foliage. When a parent landed near its brood (the maximum number of young per nest was four) it was immediately besieged, almost smothered, by the young.

October. Observed many young darters (distinguishable by their brown colour and pale necks) fishing in the canal. They are experts at catching fish, surfacing time and again with prey stabbed through with their beaks. But more often than not they lost their catch when juggling it to the tips of their beaks or tossing it in the air to swallow. We never saw an adult lose its prey in this manner.

Ardea cinerea

GREY HERON

11th July 1980. Birds in breeding colours of bright orange-red beaks and orange-yellow legs and feet, gathered in pairs at the Sapan Mori breeding colony. There were no nesting birds at the Rauji Bund 1 colony a place where they nested in 1978.

26th July. Courtship of herons was in full progress. Nest building had already begun. Observed mating frequently. It was accompanied by loud squawks. The males flew off to get nesting material, the females remained on the nest and placed the sticks in place, occasionally with help from the male especially if the stick was a large one. When the male arrived at the nest the pair greeted each other with feathers raised, their crests standing straight up, then bowed to each other by bending the joints at the tops of the tarsi.

29th August. Not many pairs managed to hatch their eggs. House Crows took a heavy toll. The birds are shyer than the other species in the colony and are easily disturbed, leaving their nests for long periods. Many pairs re-nested in a grove of babul trees across the bund in Rauji Bund 2 (see map) where they raised their young unmolested in the company of nesting Purple Herons.

Ardea purpurea

PURPLE HERON

Of all the normally resident Ciconiiformids the Purple Herons were the first to leave the Sanctuary because of the drought. By the end of November 1979 when the tall grasses and reeds of their preferred habitat had died back, they had left. In the last week of February the Forest Department had begun pumping water into Ram Bund. By the end of March this had resulted in the re-growing of tall reeds and on 2nd April 1980 two Purple Herons had returned. Between that date and early June there were always a few Purple Herons there. By June 18th their numbers began to increase until by 27th June, the date of the arrival of the monsoon, there were about 30 birds. They were in fresh new plumage.

18th July 1980. Birds sitting in pairs in the reeds.

29th July. Birds displaying in the reeds.

1st August. Went out by boat for a closer look at the nesting birds. We found a loose colony of 13 nests varying from those being built to ones with clutches of four eggs. The nests were built of sticks and lined with reeds and placed in clumps of reeds about 25 centimetres above the water.

13th August. The water intake into Ram Bund (since 15th July water had been let into the Sanctuary from Ajan Bund) was not controlled and all Purple Heron nests (as well as those of other species) were submerged and the reed beds abandoned as a heronry.

14*th August*. Birds were building nests in a patch of babul trees in Rauji Bund 2 not far from Sapan Mori, and some time later they were joined by nesting Grey Herons.

Ardeola grayii
INDIAN POND HERON

A few birds were already in breeding plumage by 26th April and by 11th May all birds had changed. Did not find one pair nesting in the Sanctuary and birds were quite scarce during the breeding season. Only during the winter months were they numerous, presumably when suitable habitat outside the Sanctuary had dried up.

Bubulcus ibis
CATTLE EGRET

Since the beginning of May Cattle Egrets in breeding plumage had been arriving at the Sanctuary. Like all the other marsh birds they congregated in the two places where water was being pumped.

15*th June* 1980. There was a sudden influx of hundreds of Cattle Egrets. They stood about in the marshy areas. Very hot day, 43°C at Agra,[4] and all day a dust storm blew.

18*th July*. Saw the traditional nesting colony in a large neem tree at Bharatpur Railway Station. About 50 nests in the tree. Most nests were in branches overhanging a platform and the tracks. Passing trains actually brushed the lower branches on which nests were built. The platform was busy and noisy but the activity was totally ignored by birds only two to five metres above the crowd. Some pairs were courting and mating. These pairs had bright orange-red beaks and facial and orbital skins. Their irises were blood-red. The birds sitting on eggs, which were in the majority, had pale-yellow irises and yellowish beaks and facial skins.

12*th August*. Scores of pairs began nesting in the Sapan Mori colony. None nested at the Rauji Bund 1 colony, where small numbers nested in 1978.

Ardea alba
LARGE EGRET

27*th June* 1980. There had been intermittent rain the previous week and egrets had been returning in increasing numbers. Today a milling multitude of all species of egrets except the Cattle Egret were fishing in the area of pumped water in Ram Bund, close to the western bund. Although all the species arrived in breeding plumage today we noticed the bright facial skin and leg colours of the Large Egrets for the first time. Of all the egrets the Large Egrets were the least in number.

11*th July*. A few pairs were displaying at the Rauji Bund 1 breeding colony.

26*th July*. All Large Egrets have left the Rauji Bund 1 colony. Courtship of a small number of pairs has begun at the Sapan Mori colony. Observed a tree of courting and nesting egrets from a tower-blind on the eastern side of the colony. One pair was building a nest about 15 metres from the blind but in a place where the actual nest was hidden from view. It was noticeable that the colour on the facial skin, orbital skin and on the tibia was beginning to fade. Courting Large Egrets had facial and orbital skin of bright turquoise and the tibia and the upper parts of the tarsi were carmine red. These colours were brightest during the days of courtship and faded rapidly once pair bonds had been established. Even the day after a pair had completed its courtship and had begun nest-building the colours started to fade. Before courtship the colours, although present, were not as bright as during courtship itself.

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[4] The nearest place for which temperature figures were available.

29th July. Entered the tower-blind, still situated in the same place as on 26th July, at 5.00 hours. At about 5.30 hours a Large Egret landed in a prominent spot five metres up in the babul tree. The bird began to display. In one continuous action it stretched its neck fully forward to peck at or grab hold of a branch, raised its plumes, spread its wings and bowed by bending its tarsal joints. Another ritual was a "wing shuffle" whereby the bird, with feathers fluffed, would in a fairly rapid motion flick its wings forward (but not out) in alternate "strokes". The effect of this action, with plumes half raised, is to see the bird shimmering. In a third display the bird opened a wing slightly and ran its beak along the edge of the primaries. This action was performed with either wing. All three displays were of approximately the same frequency with the "neck stretch" performed perhaps slightly more often. Pauses between displays were very short and the impression was one of continuous motion. At all times the back plumes were half raised, only during the "neck stretch" were they fully raised. The "neck stretch" seemed incipient nest-building as the action of the beak was similar to that of a bird placing a stick when building. The other actions are modified preening actions, though they were performed too regularly and too perfunctorily to be actual preening.

We noticed that seven Large Egrets were perched in the tree close to the displaying bird and were watching it closely. During our observations (stopped at 9.15 hours because of fierce lightning approaching the aluminium tower-blind) four of these watching birds one after another joined the displaying egret on his display platform. The two would briefly preen the plumes on each other's backs and then the displaying bird (the male therefore) would mount the bird that had joined it. Mating was attempted with three of the females without success. After the attempt the male chased the female off by pecking at her. The iris of the displaying male was pale yellow with an orange centre. At least one of the females had her entire iris bright orange. In the nest-building pair observed on 26th July both birds had pale yellow irises. The fourth female was chased off before mating was attempted. All the females were slightly smaller than the male. No nest was built at the place the male displayed. But from those and other observations it appears that the male selects the nest site, displays his colours and plumes in various rituals, attracts a female, the two mate and build a nest at or very near the display area. In nest-building (which was observed on 26th July) all the sticks were brought by the male and placed in position by the female, sometimes helped by the male. This was also observed for median Egrets, Little Egrets, Grey Herons, spoonbills and Painted Storks. In the end very few pairs of Large Egrets nested compared to the number of displaying birds, perhaps because of nest depredations by House Crows. Displays of this species and also of Median and Little Egrets were filmed in some detail and the actions and colours of soft parts are described from notes taken at the time and also from the film.

Egretta intermedia

MEDIAN EGRET

26th July 1980. This species was further advanced with its nesting and many were sitting on eggs. The sitting birds had very pale yellow irises.

One pair right in front of the blind and about $1\frac{1}{2}$ metres lower than the courting Large Egrets of July 29th, was at its selected nest site. Both birds would grab branches of the babul tree and vibrate them as though putting nesting material in place. Twice the pair mated—in silence. In this mating pair the male's iris was dark orange-red, the female's orange. The facial and orbital skins of both birds were lemon-yellow with a greenish tinge on the area immediately in front of the eye. There was more green in the female's facial skin than in that of the male. Their beaks were black. By late morning the male left to collect the first nesting material.

27th July. The pair observed mating on the 26th had progressed considerably with the building of their nest. Their irises were much paler, almost the same colour as those of the birds sitting on eggs.

28th August. Of a pair feeding four small chicks at their nest in the Rauji Bund 1 colony, one had its beak half black and half yellow and the other had its beak two-thirds yellow.

5th September. Nearly all Median Egrets were feeding young and beaks were coloured as for the non-breeding season (see Ali & Ripley, Vol. 1, 1968).

19th September. A Median Egret flew repeatedly to its nest with building material taken from another, abandoned nest. Its partner took the sticks and placed them in position even though the pair had small young.

Egretta garzetta

LITTLE EGRET

11th May 1980. In the company of a dozen Little Egrets was one of a slaty-grey colour. It was uniformly grey except for its face which was white. It had a black beak, black legs and bright yellow feet.

On 26th September we saw a bird of the same description but with breeding plumes exactly like those of the Little Egret, in the Rauji Bund I heronry. We flushed it with Little and Median Egrets from a nesting tree in the centre of the colony. We assumed it to be nesting, mated with a Little Egret of normal coloured plumage. The bird was particularly shy and as the presumed nesting site was in the centre of the colony it would have caused considerable disruption if we had tried to find the nest. So we did not pursue the matter further. We think the bird in question to be a melanistic Little Egret rather than a slaty-grey phase of the Indian Reef Heron (*Egretta gularis*) as only the face was white and the beak was all black. The grey phase of *E. gularis* has a white throat and foreneck and a largely yellow beak (Ali and Ripley, Vol. 1, 1968).

27th July. This morning two courting pairs were in the babul tree in front of the blind. They were not present on the morning of the 26th. Courting was a bowing with raised plumes with the facial and orbital skins turning coral pink during the display. After the display the colour of the skin would return to a pale greyish colour. There was no change in the colour of the iris. One of the birds had bright orange feet. All the others had yellow feet. There was no change of colour in the facial skin and feet as the season progressed.

29th July. Both pairs that were courting on the 27th were now nest-building. When the male returned with sticks to the nest his face often flushed a coral pink.

18th September. Most egrets already had well-grown young. But we found a nest of a Little Egret with five eggs at the western end of the Rauji Bund 1 heronry. In this nest one egg was nearly ready to hatch and a second was pipping. In a neighbouring tree was a nest of a Median Egret with two eggs. Another nest of the Little species had young almost ready to fledge.

19th September. Entered the blind at about 6.50 hours. Little Egret young still had not hatched though the cap of the egg was severed nearly all around. The young struggled out of the egg at 10.40 hours. The parents changed over on the nest at 12.45 hours. The new arrival mostly ignored the chick and stood on it for long periods. Eventually the adult discarded the empty egg shells by dropping them over the side of the nest.

20th September. Entered the blind at sunrise shortly after 6.00 hours. The second egg hatched shortly afterwards. The chick that hatched yesterday had dried and was sparsely covered with straggly white down. Many times the parent regurgitated small fishes for the young —but the chicks seemed too weak to pick them up. The parent, after a few moments, reswallowed the fish. Most fish regurgitated were larger than the young.

Mycteria leucocephala
PAINTED STORK

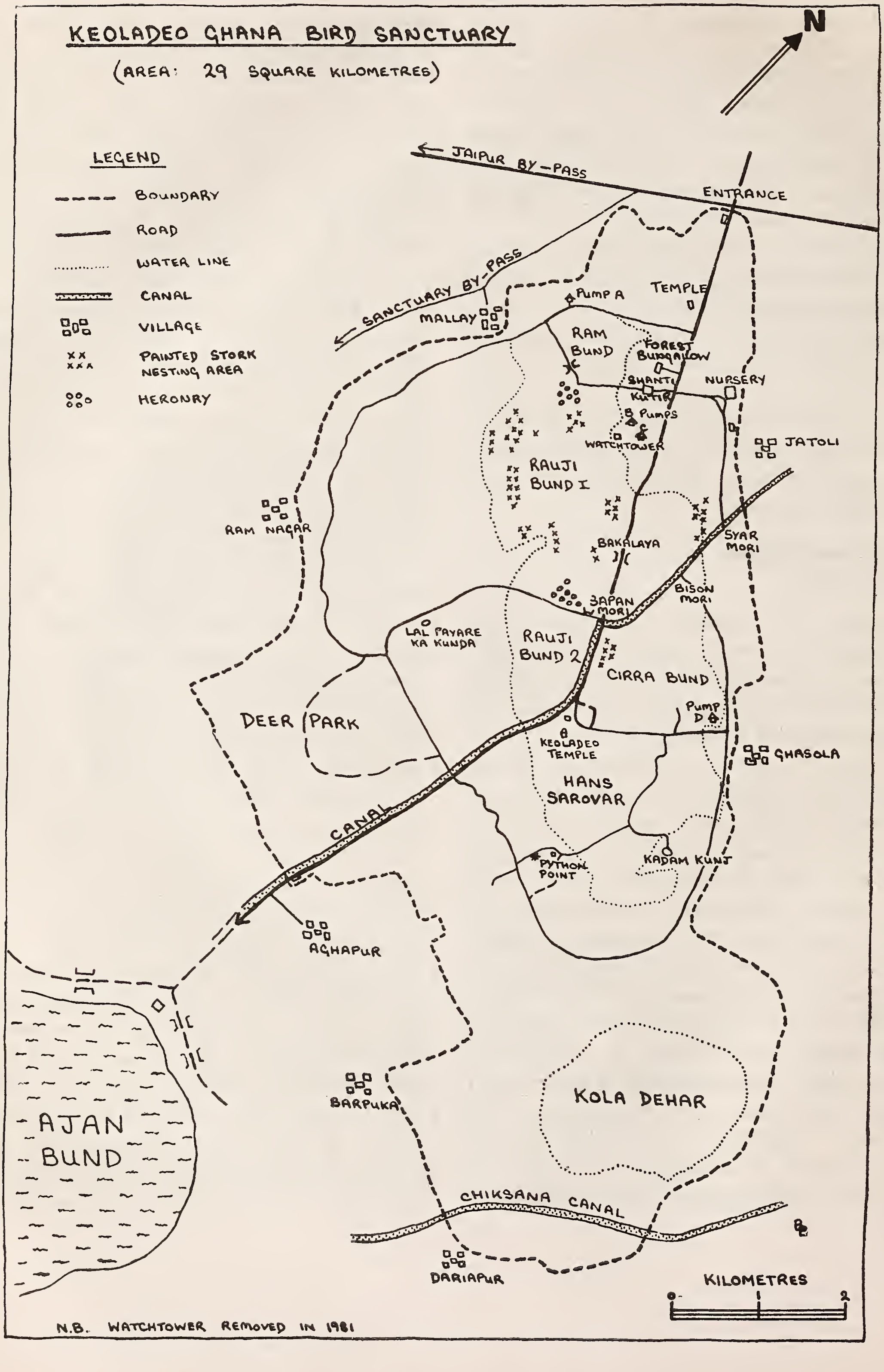
2nd August 1980. Only a few, fewer than 20, Painted Storks were on the marshes. These were the resident birds that had remained in the Sanctuary throughout the dry months. We left Bharatpur for a few days.

12th August. Returned to Bharatpur on the 11th. During our absence an estimated 600-800 Painted Storks had arrived and were now sitting in their chosen nest trees. The breeding colony was scattered and spread over a large area (see map). The birds shunned the Rauji Bund 1 and Sapan Mori breeding colonies except to visit them to pull branches off the babul trees for nesting material. Though Painted Storks have no special breeding plumage (Ali & Ripley, Vol. 1, 1968) the new arrivals were especially colourful, both in their plumage and in their bare parts. The plumage was immaculate, suggesting that the birds had recently moulted. The colour of the iris and bare parts of the breeding birds may be different from that of other times of the year. Ali & Ripley (ibid.) describe the irises of the adults as straw-yellow. Of the birds we examined and photographed closely (well over 50) all except two had either dark brown or medium brown irises. The other two had pale grey-green eyes. Ali & Ripley (ibid.) describe the beak as "orange-yellow, darker and plumbeous at base". The bills of the breeding birds were uniformly orange-yellow without any trace of plumbeous. According to Ali & Ripley (ibid.) the bare skin of the head is orange-yellow. In the breeding birds the heads were bright orange and the throats pink. Some birds had pronounced dewlaps which were pink. The legs and feet were invariably bright pink, a somewhat redder pink than that of the throat and very close to the pink of the secondaries. Ali & Ripley give the leg colour as "brown or fleshy brown, sometimes nearly red". In birds observed and photographed in late January 1980, the colours were as those of the breeding birds, though not quite as bright.

Once the birds had chosen their nest sites they stood there almost constantly. They frequently defecated down their legs. This was a deliberate action. It turned their legs white. They continued this practice till November when nesting ended and it was cooler.

During the rest of August and in early September more and more birds arrived until several thousand pairs were nesting.

17th August. The first egg had been laid in a nest which is part of a group of four nests in a clump of four babul trees situated on a small mound. The trees, no more than 2½ metres tall, were just to the east of the Rauji Bund 1 heronry, though not part of it. These Painted Storks nests were the first we found and the egg, which must have been laid early in the morning or during the night, was one of the first of the season. On the evening of


KEOLADEO GHANA BIRD SANCTUARY
(AREA: 29 SQUARE KILOMETRES)
N
LEGEND
BOUNDARY
ROAD
WATER LINE
CANAL
VILLAGE
PAINTED STORK NESTING AREA
HERONRY
JAIPUR BY-PASS
ENTRANCE
SANCTUARY BY-PASS
MALLAY
PUMP A
TEMPLE
RAM BUND
FOREST BUNGALOW
SHANTI KUTIR
NURSERY
B PUMPS
WATCHTOWER
JATOLI
RAUJI BUND I
RAM NAGAR
BAKALAYA
SYAR MORI
BISON MORI
SAPAN MORI
LAL PAYARE KA KUNDA
RAUJI BUND 2
CIRRA BUND
PUMP D
DEER PARK
KEOLADEO TEMPLE
GHASOLA
HANS SAROVAR
CANAL
PYTHON POINT
KADAM KUNJ
AGHAPUR
AJAN BUND
BARPUKA
KOLA DEHAR
CHIKSANA CANAL
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2
N.B. WATCHTOWER REMOVED IN 1981

the 16th August there were no eggs in the nests. We watched these four nests daily till all eggs had been laid and then again almost daily till they hatched to determine their incubation periods. Of the four nests two had clutches of two eggs each and two had clutches of three eggs each. In one of the three-egg nests all eggs failed to hatch and in one of the two-egg nests only one egg hatched. Of the remaining six eggs two hatched after 27 days, two after 28 days and two after 29 days. Time of hatching (observed for four eggs) varied from 10.22 hours to 18.15 hours.

On August 17th our tower-blind was set up facing a group of 22 nest-building pairs in a single spreading babul tree approximately six metres tall. The tree was in Rauji Bund 1 about 300 metres SW of the heronry. Many pairs were busy in mutual preening. Mostly they preened each other's necks by very gently nibbling with their beaks. Sometimes the pair would preen each other simultaneously at other times one would stand with eyes closed while being preened by its partner. Often the pair dozed, one resting its head on the other's back. After a preening session some pairs mated. During mating both birds clappered their beaks individually but also one against the other producing a unique sound. After mating the males set off to gather nesting materials. Nearly always they brought babul branches, some very large up to a metre long, which they pulled off with powerful jerks of their beaks. Mostly they brought green branches but some birds specialised in dry twigs broken off dead, standing trees. Birds arriving on their nests would be greeted with a short burst of beak-clappering and the two would place the twig or branch in place with vibrating movements of their beaks. If the arriving bird did not bring nesting material the pair would greet each other with an "Up-Down" display as described by Kahl (1970). The loudest and most sustained clappering occurred during disputes, usually over nest sites or over sticks used in nest-building.

20th August. In the large tree observed on 17th August four nests now had one egg each. Two pairs with eggs in their nests, mated. When the day became hot one of a pair would sit on the eggs. Its partner would then spend up to half an hour preening the sitting bird's neck feathers with very gentle nibbling movements of its beak tip.

Once the second egg had been laid the birds spend very little time at the nest together. One would incubate while the other was out feeding. During nest site selection, courting and nest-building both birds were at the nest site or nest all day—sunrise to sunset. This is a period from 4 to 7 days. During this time the birds do not seem to feed unless they feed at night. Nor did we see any Painted Storks feeding in the Sanctuary at that time, though we searched for them.

16th September. The blind was set up at the four nests in the low babul trees near the Rauji Bund 1 heronry. An adult was seated on each nest and remained there till 8.50 hours when all four stood up in quick succession. They preened themselves and then stood with wings spread shading the eggs and young. Nest number one had a day-old young and nest two a two-day old young. These were the first Painted Stork chicks to hatch in the Sanctuary to the best of our knowledge. At 10.18 hours the adult on nest number two fed its chick on lumps of what looked like a yellow-brown paste. The chick ate some and the adult re-swallowed the remainder. At 10.22 hours a chick hatched at nest number one, the adult immediately threw the egg shells over the side of the nest. At 11.00 hours, when we left the blind, the birds were still standing, shading the eggs and not sitting and incubating. At 6.33 p.m. a young hatched in nest number four.

26*th September*. At the nests in the low babul trees, nest number one was deserted, we found dead chicks underneath it in the water. At nest number two chicks were growing very rapidly. Both parents were at the nest. One after another the parents went out and collected water in their beaks and presumably their gullets. When they returned they poured copious amounts of water over the chicks (which were still covered in white fluff) and down their throats. Once the chicks were fed on small fishes. The older chick snapped up the regurgitated fish from the parent's beak while the smaller one (there was three days difference in their age) picked up fish from the floor of the nest. Nest number four contained a single young which hatched on August 16th. The parent attending the young regurgitated two very large fish (both without heads), too large for the young to swallow. Time and again the young attempted to swallow the smaller of the two fish, often sprawling on the nest floor with exhaustion with the fish in its beak. Four times the adult regurgitated the two fish and reswallowed them but the young could not swallow either.

A pair of Spotted Munias and a pair of White-throated Munias were busy building nests into the undersides of the Painted Stork nests. Painted Storks were still not seen fishing in the Sanctuary. Birds returning to the nest to feed young came from outside. Those nesting in Rauji Bund 1 nearly all came from due north. They returned in flocks of six to twelve birds and then spread out to individual nests.

18*th October*. All nests in the low babul trees had fallen when the trees collapsed in a storm. Only one young survived, by crawling onto the small mound on which the trees stood. By now the young was quite large, almost fully feathered. The parents had built a nest on the mound around the chick, and continued to feed it.

20*th October*. A lot of Painted Storks had taken up what at first appeared to be nesting territories at both the Sapan Mori and Rauji Bund 1 heronries. They vigorously defended their "territories" and even carried nesting material to them. But there was no courtship and no mating, and no real nests were built. Many of the "nest sites" were occupied by single birds. Before this time Painted Storks came to the heronries only to collect nest-building material.

Anastomus oscitans

OPENBILL STORK

15*th June* 1980. Day of a dust storm. Bharatpur very dry. Maximum temperature at Agra (nearest centre for which figures are available) was 43°C. Yet several hundred Openbills had arrived and taken up residence in Ram Bund which was green as a result of water being pumped into it from bore A.

26*th June*. These storks had increased to close to 1000. Numbers of them were standing in the tops of babul trees in Rauji Bund 1 behind Shanti Kutir, pulling at the vegetation and going through the motions of nest-building. They were the first birds to gather in the trees preparatory to breeding. The trees in which they had congregated eventually became the Rauji Bund 1 breeding colony. But in June the marsh here was still completely dry.

11*th July*. A small amount of water had collected in Rauji Bund 1. Many pairs of Openbills already had finished nests. Until now the birds were black and pure white in plumage. We observed hundreds of Openbills feeding deep in the woodlands well away from the marshes in areas flooded by recent heavy rain. They were catching snails, frogs and insects.

14*th July*. Observed a corner of the breeding colony from our tower-blind. The nests had one egg each, the first eggs we had seen. While birds were off their nest due to a disturbance a crow came, broke one of the eggs and ate the contents. When the owner of the nest returned, it picked up the empty egg shells and tossed them over the side of the nest. The nest was not abandoned for at least another two days.

13*th August*. There had been a considerable decline in the number of Openbill nests since July 19th. But those of egrets, cormorants and darters had increased. All the Openbills had changed colour. The parts that were pure white when the birds arrived were now a dull grey. It would be interesting to determine the mechanism by which the birds' colour changes. We did not notice them moulting. Also the change is uniform and not in patches. The grey colour is the same as that of the young when they fledge. Like the Painted Storks, Openbills were seen showering their nestlings with water during the hot time of the day.

Ciconia nigra

BLACK STORK NR

2*nd March* 1980. In the afternoon we saw three Black Storks on the dry mud of Cirra Bund. They were seen for only one day. This seems a new record for Bharatpur as it is not listed by either Abdulali and Panday (1978) or Saxena (1975).

Ephippiorhynchus asiaticus

BLACKNECKED STORK

January 1980. See under White Pelican for interaction with that species.

1*st April*. Observed one catching and killing a Pond Heron. After killing it the stork flew off with the bird and we could not see how or if it ate the Pond Heron.

Anser indicus

BARHEADED GOOSE

17*th December* 1979. In company of about 50 normal coloured birds we noticed a partial albino. The general impression was of a white bird but closer examination revealed faint traces of the pattern on the head, neck and flanks. Beak, irises, feet and legs were all of normal colour. This bird may have given rise to the rumour that a Snow Goose had been seen in the Sanctuary.

About 500 to 1200 Barheads remained in the Sanctuary throughout the winter, feeding on the growth of grass in areas at Ram Bund and Cirra Bund that were flooded as a result of water pumped from bores A and B. In late March and early April the birds left the Sanctuary. A major exodus occurred on the night between April 1st and 2nd. The last we noticed were a few individuals on 26th April 1980.

Dendrocygna javanica

LESSER WHISTLING TEAL NBR

4*th September* 1980. A pair with 8 ducklings only a few days old swam close to the blind set up in the western end of the Rauji Bund 1 heronry.

18*th September*. The pair was still in the same place and still with 8 ducklings.

26*th September*. Pair with eight ducklings was still in the same area. Two other pairs were close by, one had seven ducklings and the other five all approximately the same age. Today was the first day we could observe all three pairs from the same vantage point.

Tadorna ferruginea
RUDDY SHELDUCK

A few birds stayed right through spring and early summer in the flooded areas. On 26th April there were seven. We saw sixteen on May 17th. The last one, on its own, was in Ram Bund on 15th June 1980.

Tadorna tadorna
COMMON SHELDUCK

We first saw these birds (three) on 17th November 1979. They stayed throughout the winter in the small shallow pools left in Cirra Bund. This species is a rare visitor to Bharatpur. It was first recorded by Sauey in 1977 (Sauey, pers. comm.).

Anas poecilorhyncha
SPOTBILL DUCK

In normal seasons, when the marshes do not dry up, Spotbill Ducks begin nesting in March in Bharatpur (Abrar Khan, pers. comm.) and continue to nest till September-October. No nesting was observed or ducklings seen during the spring of 1980. No Spotbill Ducks were observed, except for the occasional visitor, during April and May.

22*nd June* 1980. There had been some rain the previous day and several hundred Spotbills had arrived. They congregated in the muddy puddles on Cirra Bund. From this date on there were numbers of Spotbills in the Sanctuary.

4*th September*. We were shown a nest on a mound in a small marsh on the eastern side of the road between Bakalaya and Sapan Mori. It contained seven eggs. On the day we first saw it the sitting bird was being harassed by a Marsh Harrier in immature plumage. The harrier hovered over the nest, landing periodically near it. Whenever the harrier landed the duck would rush towards it and drive it off. This meant that the duck rushed from one end of the mound to the other. It would leap up at the raptor as it hovered closely overhead. Occasionally the harrier would fly away, only to return a short while later.

On 6th September we found the nest abandoned and containing broken eggs.

15*th September*. Another nest on a mound near the watchtower was pointed out to us. It contained 10 eggs.

This nest was also robbed of its eggs. Both nests were discovered by Forest Department labourers clearing the mounds of grass and weeds so that the planted babuls could grow more quickly. Despite the presence of the nests the mounds were cleared, leaving the nests exposed.

Anas querquedula
GARGANEY TEAL

14*th May* 1980. Three birds in Ram Bund.

15*th July*. Observed 13 birds in Cirra Bund close to the Keoladeo Temple.

13*th August*. In late afternoon a flock of about 30 birds flew overhead and then settled in the open water in Ram Bund.

Nettapus coromandelianus
COTTON TEAL

22*nd June* 1980. These birds had also left during the winter. But on this date, after some rains, many pairs and threesomes were flying fast circuits over the marshes, while vocalising in a rapid quacking call.

17*th July*. These birds were still engaged in courtship flights. Threesomes were invariably made up of one female and two males. Occasionally they would alight in large trees where the females would inspect possible nestholes. Pairs were often seen perched in trees. In one threesome the two males fought in mid-air, one male grabbing the other by the neck with his beak. The two crashed into the branches of a babul but soon recovered and flew on after the female, quacking loudly.

22nd September. Checked three nests in hollows in trees besides the Keoladeo Temple. Two nests were in hollows only 1½ metres apart in a jamun tree. One nest contained four ducklings and eight eggs, the other contained five eggs. The third nest was in a babul tree and contained three eggs.

27th September. Saw a female with 17 small, downy ducklings at Sapan Mori, only about 20 metres from the road.

Sarkidiornis melanotos

COMB DUCK

This species also left the Sanctuary during the dry months.

12th August 1980. Found a nest in a hollow limb of a babul along the bund about half a kilometre east of the Keoladeo Temple. It contained 17 eggs. Three of the eggs were very small and about the size of those of a Cotton Teal. Perhaps the Comb Duck had taken over the nest hollow of a Cotton Teal.

27th September. In a flooded field immediately below Ajan Bund we observed a Comb Duck with 17 ducklings at least one week old.

Pernis ptilorhynchus

HONEY BUZZARD

We noticed this bird in the Sanctuary from March 1980 onwards.

22nd June 1980. Abrar Khan showed us a nest he had found. It contained two eggs. The bulky stick nest was 8¼ metres high in a kadam tree. The tree was about 15 metres east of the road and about half a kilometre south of the Shanti Kutir turnoff.

5th July. The nest contained one newly hatched chick and one egg.

7th July. The second egg was pipping.

12th July. The nest was empty except for the fresh carcass of a Pied Mynah, presumably brought by the parents to feed the young. On the 11th we saw an Eagle Owl low in a tree only about 10 metres from the nest. Perhaps it took the young as owl of the genus *Bubo* are known to take the young of other raptors (Newton 1979).

Milvus (migrans) lineatus

BLACKEARED KITE NR

This distinctive subspecies of the Black Kite, with its "conspicuous white buzzard-like underwing patch" (Ali & Ripley, Vol. 1, 1968), is recorded from Delhi by Abdulali and Panday (1978) but not from Bharatpur. It is not listed by Saxena (1975). We saw and filmed two of these kites at Ajan Bund on 17th October 1980.

Aquila clanga

GREATER SPOTTED EAGLE

23rd December 1979. We saw three immature Spotted Eagles on some kind of prey out in the NE corner of Hans Sarovar Bund. The marsh was virtually dry, only a few patches of soft mud remained. We walked over to investigate. One of the eagles was larger than the other two and was feeding. The others stood a little to one side. The bird they were eating was a large owl of the genus *Bubo*. This could be determined from the head, legs and feet which were still intact.

24th December. A Greater Spotted Eagle in immature plumage was feeding on some indeterminate meat. While it was feeding a Sarus Crane walked up to it, approaching to within a few centimetres of the eagle. The eagle raised its hackles, opened its beak wide, spread its wings and struck out with its talons. After a few minutes the Sarus walked away.

26th December. In Rauji Bund 1, due west of Shanti Kutir we observed an eagle in adult plumage feeding on a dead spoonbill in shallow water.

29th January 1980. Early in the morning an eagle was feeding on a large catfish left stranded in the canal near the Keoladeo Temple by the pelicans. It's bill did not seem suited to fish eating for it could tear off only small pieces of flesh and skin. It fed for more than two hours. This was in sharp contrast to a Ringtailed Fishing Eagle, which fed on a catfish it had caught. The Fishing Eagle was able to pull off large pieces of flesh and finished its fish in less than 10 minutes.

Haliaeetus leucoryphus

RINGTAILED FISHING EAGLE

For a number of years two pairs have nested in the Sanctuary. One pair in the northern end of Ram Bund the other on the far eastern side of Cirra Bund close to the eastern bund itself. In the winter of 1979-80 the Ram Bund pair did not breed. Frequently we saw them sitting on an old nest, but they used it only as a feeding platform. We did not see the birds carry nesting material, nor were eggs laid. For the previous seven years (Abrar Khan, pers. comm.) the female laid eggs each winter. But not once did the eggs hatch. All the old nests, of which we counted five, are in tall kadam trees on the northern edge of Ram Bund.

5th December 1979. On the evening of December 4th, while driving to Bharatpur, we picked up a hare freshly killed by a truck. On the morning of the 5th we put this out in a conspicuous place in a dry area of Ram Bund, well within view of the female Fishing Eagle. We hoped to film the bird on the hare. We watched the Eagle from 8.00 hours to 17.00 hours, but she never once left her perch.

13th December. The pair nesting in Cirra Bund had two eggs in their nest. The huge stick nest was in a dead kadam tree at a height of 16½ metres. The tree was about 150 metres from the eastern bund and approximately half way between Bison Mori and the southern bund.

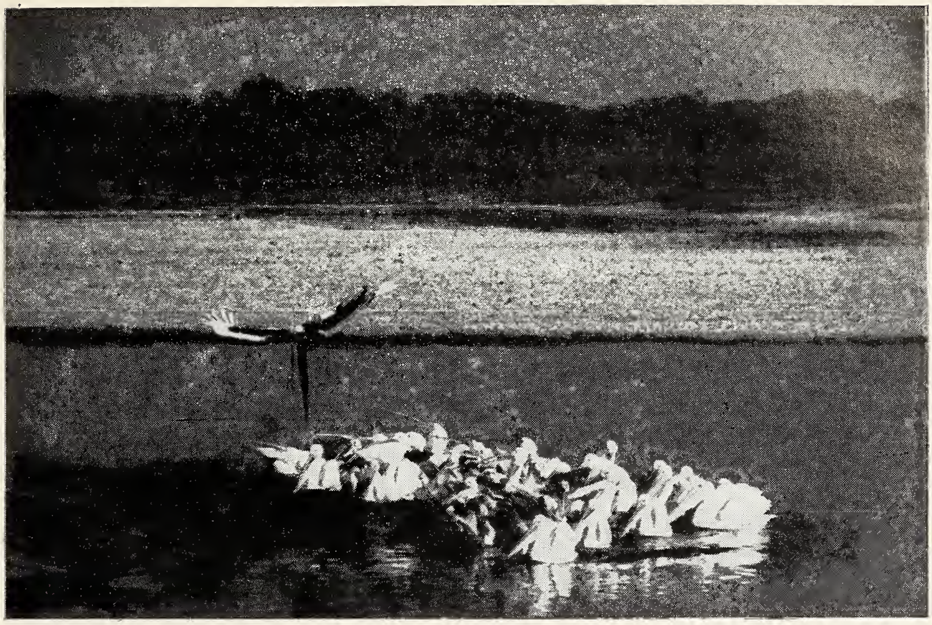
22nd December. At 11.40 hours a Forest Guard climbed up to the nest to check its content. The female eagle did not leave the nest till the guard had climbed to a height of four metres, then she circled low, making clicking noises. The male also came and settled in a nearby tree. The guard reported that there were two young in the nest, white and downy and very small. One young was larger than the other and the smaller one appeared damp. There were two fish, each about 30 centimetres long, on the nest rim. Only small pieces had been eaten. By the time we had walked less than a 100 metres from the nest tree, both birds had returned to the nest.

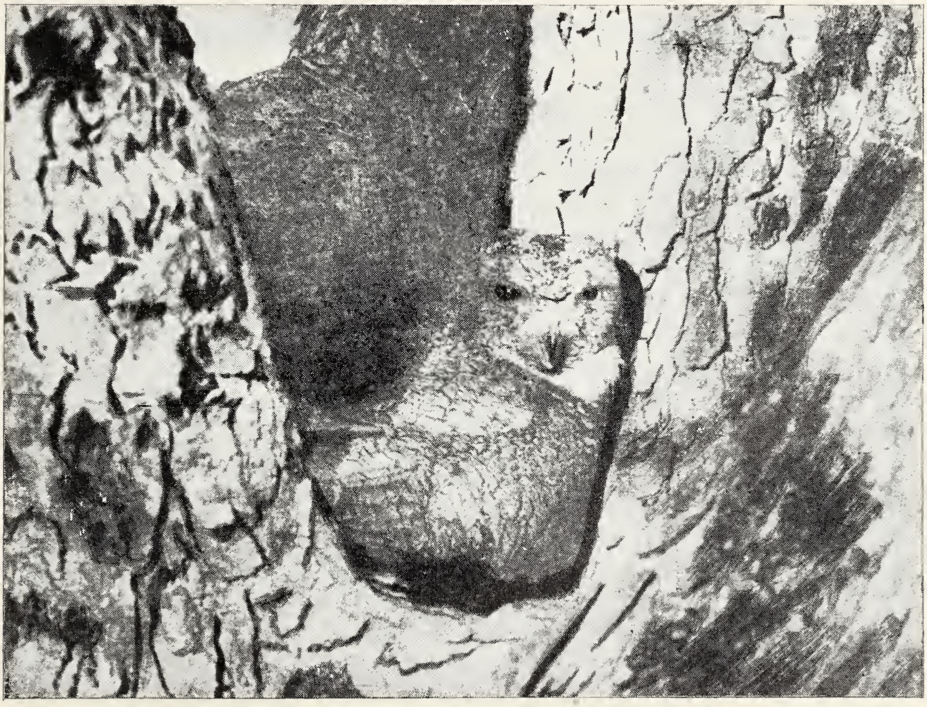
24th January 1980. Saw parents feed chicks.

26th January. We checked the contents of the nest. It was empty. The adults were sitting in a neighbouring tree. Perhaps the young had been taken by Dusky Horned Owls which are common in the area. According to Newton (1979) owls of the genus *Bubo* are known to take the young of raptors. He reported that most of this predation is on large young no longer covered by the female at night.

17th February. The base of the eagle's nest tree had been deliberately set on fire by herdsmen. The huge tree toppled.

This was one of many dead kadam trees cut or burnt down during 1979-80. The wood was taken out within days by herdsmen and other villagers. The Fishing Eagles remained in the area.

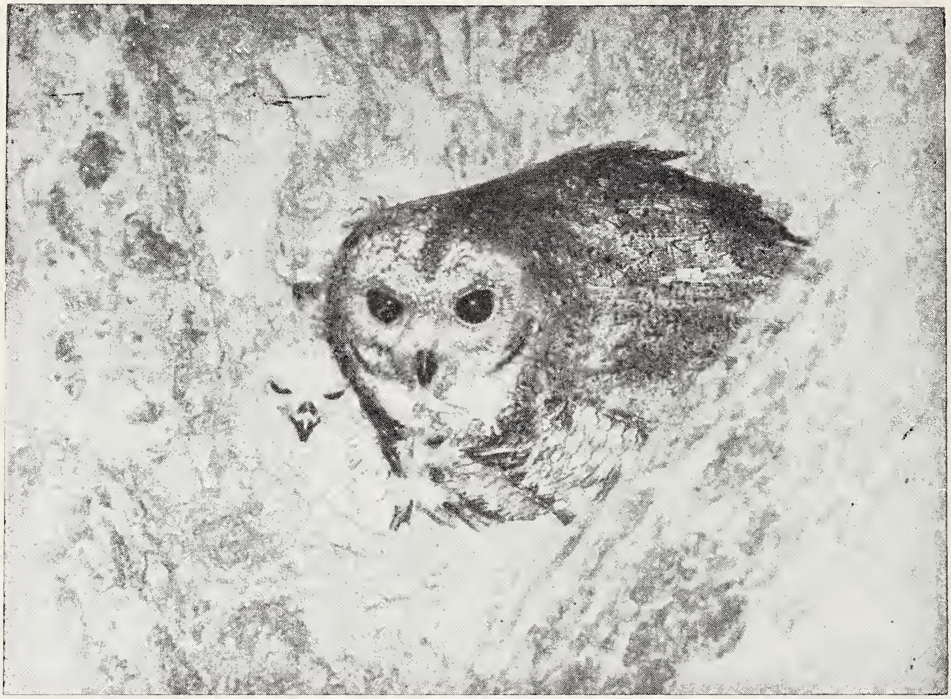


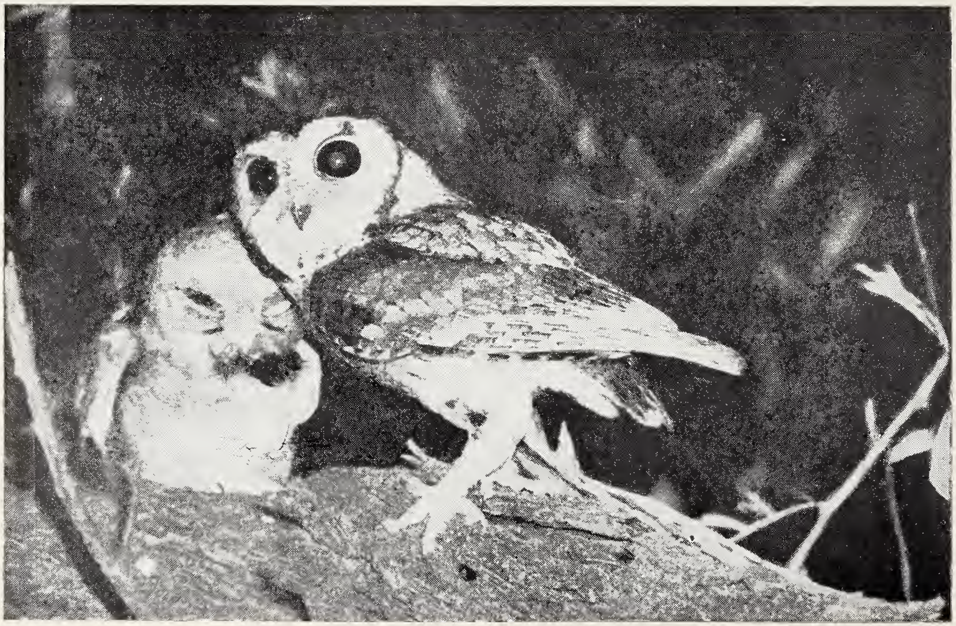


Above: Male Blacknecked Stork attacks a group of White Pelicans in Cirra Bund. January 1980.

Below: Female Mottled Wood Owl on its nest in a neem tree. Photograph was taken in the daytime. April 1980.

(*Photos*: Stanley & Belinda Breeden)





Above: Female Mottled Wood Owl feeding its chicks on a Roseringed Parakeet. Photograph was taken at night. April 1980.

Below: Collared Scops Owl feeding young almost ready to fledge. Photographed at night. April 1980.

(*Photos*: Stanley and Belinda Breeden)

Sometime in late March or early April both pairs of eagles left the Sanctuary.

26th August. A male eagle had returned to Ram Bund.

4th September. A pair of eagles had returned to the eastern side of Cirra Bund.

6th September. The pair had begun building a nest in a tall jamun at Bison Mori.

27th September. The pair built a new nest in the top of a babul tree only about 30 metres from the jamun. They appeared to be brooding eggs. The nest was in too thin branches to climb safely.

17th October. A large (female) Ringtailed Fishing Eagle in immature plumage arrived at Ram Bund. When we left Bharatpur on 13th November she was still there. The adult female, normal resident in this area, had not returned by this date.

Neophron percnopterus ginginianus

INDIAN SCAVENGER VULTURE

From September 1979 onwards the Indian Flapshelled Turtles, *Lissemys punctatus,* left the drying marshes in large numbers. In what seemed a random movement, they wandered off in all directions, keeping walking until they found shelter in the woodlands or areas of pumped water. To reach the shelter of dense vegetation or ground litter they had to walk many kilometres over bare ground. Amongst the birds there was only one predator on these turtles and that was the Scavenger Vulture. These birds would walk up to a turtle, turn it over, and dig underneath one of the rear flaps with its sharp and narrow beak. Only these vultures could open the flaps. Once opened, King Vultures and Whitebacked Vultures would often commandeer the turtle. We saw turtles wandering about and Scavenger Vultures feeding on them till about two weeks after the rains arrived, i.e. about July 10th 1980.

28th November 1979. A vulture in immature plumage, carrying a stone in its bill, walked up to a turtle lying upside down in a dry marsh and then dropped the stone on the turtle's shell. It was an action very similar to that observed of the Egyptian Vulture (*Neophron p. percnopterus*) in Africa which uses stones to break the eggs of ostriches (Van Lawick-Goodall 1970).

Circus aeruginosus

MARSH HARRIER

We saw the first bird to arrive from migration on August 13th 1980. It was in immature plumage, as were all the birds we saw this season. Apart from taking the eggs from a Spotbill's nest, we saw a harrier take the eggs of a Purple Moorhen (26th September), and a nestling of a Little Cormorant (20th September).

Falco peregrinus

PEREGRINE FALCON

Abdulali & Panday (1978) rate the Peregrine as occasional at Bharatpur and Saxena (1975) considers it rare. Neither list specifies the subspecies. On 26th January 1980 we saw a Peregrine perched in a dead kadam tree in full sunlight and we could approach it closely. With the aid of a friend's powerful telescope we were able to identify it as *F. p. japonensis.* The black cap and moustachial stripes and very pale, almost white, underside were diagnostic.

Grus antigone

SARUS CRANE

In December 1979 there was a tremendous influx of Saruses every evening into Cirra Bund and the NE portion of Hans Sarovar

Bund. The birds began to arrive about an hour before sunset and continued to stream in until dark. Some arrived even after dark. All but a few left again at sunrise.

20*th December* 1979. We counted the Saruses at 18.05 hours. There were 194 in Cirra Bund and 240 in adjoining Hans Sarovar Bund. This appears to be the largest concentration of Saruses recorded in the Sanctuary (Sálim Ali, pers. comm.).

During March and April 1980 when pumped water began to collect in Ram Bund, the top end of Rauji Bund 1 and Cirra Bund, Saruses remained feeding there all day. Most days there were well over 100 Saruses in both Cirra Bund and Rauji Bund 1. On April 4th, in mid-afternoon we counted 238 Saruses at Cirra Bund alone and on 19th April there were 101 at Rauji Bund 1. On 17th May there were 214 Saruses at Cirra Bund but none at Rauji Bund 1 where pumping had stopped. Water was shrinking at Cirra Bund in the latter part of May as power cuts restricted the pumping. On May 23rd there were only 63 Saruses at Cirra Bund and none at Rauji Bund 1. Once the rains started, on June 21st, the Saruses dispersed and were present in only small numbers.

In good seasons Saruses begin nesting in March, but in 1980 none nested before the rains.

18*th July* 1980. We watched two different pairs of Saruses build nests in shallow parts of Rauji Bund 1. The birds pulled up grasses and other aquatic vegetation and tossed it into a pile. The effect was to create a small platform surrounded by a narrow moat of water.

13*th August*. From a distance we saw a Sarus sitting on a treeless mound just NW of the watchtower. The bird appeared to be sitting on a nest. We poled towards it in a boat and only when we were within a few metres did the bird stand up and walk away. But it was not incubating an egg, it had been sitting on a stone, roughly the size of a Sarus egg. The stone was pale yellow-brown in colour, and pitted with small holes. We watched a pair of Saruses in this same area till early November, but though they built several nests we never found any eggs or saw any chicks.

14*th August*. Found a nest with two eggs at Bison Mori. On 8th September we observed the nest from a distance. Both parents were there. There were two chicks on the nest—one stood strongly upright. The other was smaller, still wet and still at the tottering stage. One parent carried off some eggshells; the smaller chick must have just hatched. On 15th October we filmed a pair of Sarus with two well grown young at this nest site. Young were still being fed by their parents.

17*th August*. We found two nests, each with two eggs, in the northernmost portion of Rauji Bund 1. We found the chicks from one of the nests when the chicks were approximately one week old. This was on September 14th.

20*th August*. We found a nest with one egg about 80 metres west of the main road at a level with the watchtower. We checked this nest daily and the second egg was laid on August 23rd. There is not much information on the incubation period of the Sarus Crane. Ali & Ripley (1968), quoting Lahiri, say it is 28 days. The Moghul Emperor Jahangir states in his memoirs that the eggs hatched after 34 days incubation (Ali 1927). At the International Crane Foundation it was found that Sarus eggs hatch after 30-32 days in an artificial incubator (Sauey, pers. comm.). On September 21st we could hear a chick chipping in each egg and from one we could hear pipping sounds. On 23rd September one egg was pipping at 6.12 hours. At 16.00 hours the second egg was pipping and the first egg was almost ready to hatch. We left the nest at 18.30 hours and returned at 19.30 hours by which time the first had hatched. It was full moon. We returned to the blind at 6.00 hours on September 24th. At 6.05 hours both adult Sarus arrived at the nest. The male ate the membrane and eggshell of the egg which hatched the day before. Shortly after 10.00 hours the chick, still unsteady, stumbled off the nest. The male stayed with it and fed it small items very, very gently. At sunrise on September 25th the second egg was almost ready to hatch. The female brooded it while the male stayed close-by with the first chick. When the second egg hatched at 9.40 hours the male joined the female on the nest. Both parents swallowed small portions of the eggshell but the male carried most of the shell and membrane off and dumped them a few metres from the nest. So the first egg hatched in 34 days and the second in 33.

Grus leucogeranus
SIBERIAN CRANE

Of the 14 species of Crane, the Siberian is considered the most endangered by the International Crane Foundation (Sauey, pers. comm.). Once this species occurred over a fairly wide area of northern India (Hume and Marshall 1880). But in recent years Bharatpur Sanctuary has been the only known wintering ground for this species in India. And even during that time there has been a drastic decline in the numbers coming to Bharatpur. Below are the numbers of birds recorded for the Sanctuary for the decade 1970-1980. The figures have been compiled by the International Crane Foundation.

March 1970 — 76 cranes
Winter 1974-75 — 63 „
February 1976 — 61 „
February 1977 — 57 cranes
February 1978 — 55 „
Winter 1978-79 — 41 to 43 „
Winter 1979-80 — 33 „

In spite of the fact that the Siberians are undoubtedly the Sanctuary's most important species, they suffered the worst from the drought of 1979-80. The birds fed almost exclusively at Cirra Bund and, when at Bharatpur, were seen in other locations within the Sanctuary only a few times and usually as a result of a disturbance at Cirra Bund.

Cirra Bund was the last to dry up and with two exceptions the area of soft mud and shallow water within this Bund was the only place the cranes were seen feeding. The other two places were a small pond only a few metres in diameter at Sapan Mori where two of these cranes briefly fed on January 28th 1980, and Ram Bund where a single Siberian stayed from March 18th to 30th.

No matter what the time of day the Siberians were always feeding when we observed them, even during moonlit nights. They spent no extended periods preening. Unison calls and other interactions were extremely rare. The only vocalisations, apart from the very occasional unison calls, were soft calls during flight. Feeding required the expenditure of a great deal of energy, the birds having to move substantial quantities of mud to uncover the small tubers on which they fed. The tubers were not as numerous as in normal years.

The drying up of Cirra Bund, the only place in the Sanctuary the cranes could feed, meant that the birds were disturbed quite often by herdsmen and also by tourists. Neither the herdsmen and their buffaloes nor the tourists were effectively controlled by the Sanctuary management. Whenever the cranes were disturbed they would circle over the Bund for a few minutes or sometimes for several hours and then invariably fly off to a destination outside the Sanctuary. Often the cranes left the Sanctuary for many days on end. It was never discovered where they went.

Water pumped into Cirra Bund from pump C was for some reason directed towards the eastern portion only, an area devoid of Siberian Crane food.

The conditions for the cranes and their behaviour during the 1979 drought was very different to that in a normal season. We observed this species in January 1975 and again in February 1977. In both these winters there was enough area of marsh so that the cranes, if disturbed (which happened rarely), could move to another area. They never left the Sanctuary. Food was plentiful in all the major Bunds. The birds interacted frequently and their unison calls were heard daily and often. They spent long periods preening.

The first Siberian Cranes arrived on December 7th 1979. Four of the birds arrived that day. By December 15th twelve cranes were at Cirra Bund including one juvenile. On 18th December all twelve cranes flew off at 14.00 hours. One returned at 16.00 hours. On 19th December seven cranes arrived—two at 9.00 hours, two at 11.56 hours and three (including a juvenile) at 12.00 hours.

On December 20th and 21st there were eight cranes all day. On the 22nd the eight cranes were joined by a further two at 16.50 hours. On 23rd December the cranes were disturbed at 9.20 hours by a tourist and flew up but all returned by 10.00 hours. Two more Siberian arrived between 15.30 hours and 16.30 hours. On December 25th only eight cranes remained and all of these took off in a NW direction in the afternoon of December 26th.

We were absent from Bharatpur from December 27th 1979 to January 7th 1980. On the morning of January 8th 33 Siberian Cranes were recorded (Abrar Khan, pers. comm.), but that afternoon, when we arrived only 16 were left, including three juveniles. The morning of January 8th was the only occasion during the whole winter that all 33 cranes were seen in the Sanctuary. On January 14th we saw 28 Siberian Cranes, but this was the only occasion we saw that many. There were no cranes on January 17th. On January 24th and 25th there was one pair. On the morning of January 26th the pair was joined by another pair accompanied by a juvenile. One of the new-comers squatted down and slept with its head resting on its back. The other fed and the young just gazed around. This trio left again on January 27th. On January 28th the "resident" pair were joined by another pair. At about midday both pairs were disturbed by a herdsman and left the Sanctuary. We were absent from Bharatpur from February 1st to 16th. On the 16th only one pair was in the Sanctuary. According to Abrar Khan these two cranes were present nearly all the time we were away. On February 11th they were joined by six others (Abrar Khan, pers. comm.)—two pairs, each with a juvenile—but they only stayed a few hours. The "resident" pair left on February 28th 1980. According to Abrar Khan six Siberian Cranes arrived on the evening of March 3rd and left again at 9.30 hours on March 4th. From March 18th to 30th a single Siberian Crane stayed in Ram Bund and then left the Sanctuary.

Porzana pusilla

BAILLON'S CRAKE

We first noticed this species on August 19th 1980 and saw it regularly after that. Although we looked for nests when flushing the bird, we never found one. We always saw it on the aquatic vegetation such as grasses and waterlilies while we were out in a boat.

Amaurornis akool
BROWN CRAKE NR

We first identified this bird in the Sanctuary on 17th November 1979 and saw it regularly until the breaking of the monsoon. We did not see it after that. Neither Abdulali and Panday (1978) nor Saxena (1975) list this species for Bharatpur.

Amaurornis phoenicurus
WHITEBREASTED WATERHEN

At dusk on August 19th we observed a Whitebreasted Waterhen leading its chicks from a bund out on to the marsh. The adult folded some grasses over to form a platform after which it fluffed itself out and brooded the four small, black and downy young.

Porphyrio porphyrio
PURPLE MOORHEN

There were no Purple Moorhens observed during the winter, spring and early summer. We first noticed this species in very small numbers at Ram Bund on June 18th. On July 18th pairs were busy courting and making nest-platforms by bending the reeds. By 24th of July there had been a big increase in numbers in all parts of the marshes. We found five nests in Ram Bund on August 1st, the number of eggs varied from two to five per nest. All these nests were built in tall reeds. By 13th August the nests were submerged as a result of water let into Ram Bund from Ajan Bund. Between 17th August and 15th September we found nine more nests. Completed clutches varied from four to seven. All these nests were in aquatic grass in the area west of the watchtower in Rauji Bund 1.

Hydrophasianus chirurgus
PHEASANT-TAILED JAÇANA

We spotted the first jacana in breeding plumage on May 9th 1980 in the green grassy area around pump D in Cirra Bund. Large numbers arrived in early June when scores of pairs were calling in Cirra Bund, Ram Bund and Rauji Bund 1. We saw a loose congregation of 35 in Ram Bund on 22nd June. By June 25th numbers were fewer throughout the Sanctuary; perhaps 30 pairs where before there had been several hundred individuals. On July 19th we observed a nest from a blind. The nest was out in the marsh 12 metres from the northern bund of Ram Bund. Our observations began at 16.00 hours and lasted for about two hours. The floating nest was in the open water so the bird could not walk to it, but had to fly. When it first arrived the bird was wet from wading in some damp grass. Before settling on the four eggs the bird removed the water drops from its underside with sweeps with its beak. Then the bird incubated the eggs by scooping them under itself with its wings. The wings were between the eggs and the damp surface of the nest. The spurs on the bird's carpal joints were clearly visible. Between 1st August and 15th September we found six more nests—all of them in Ram Bund and the northern edge of Rauji Bund 1.

Metopidius indicus
BRONZEWINGED JAÇANA

Like the Pheasant-tailed Jacana, this species was absent from the Sanctuary from December onwards. We noticed the first arrival on June 18th, a single bird. This species was not nearly as numerous as the Pheasant-tailed Jacana, nor was it as vocal. We found the first nest of this species on August 1st in the southern part of

Ram Bund. It contained one egg. When we next visited the nest on August 13th there were four eggs. The nest was a densely packed, floating mass of acquatic vegetation in a patch of sparsely spaced reeds. It seemed to be loosely anchored for the nest would float only a few centimetres whenever a breeze sprang up. The nests of both species of jacana, which were subject to the same rising waters as those of the Purple Moorhens, were not inundated.

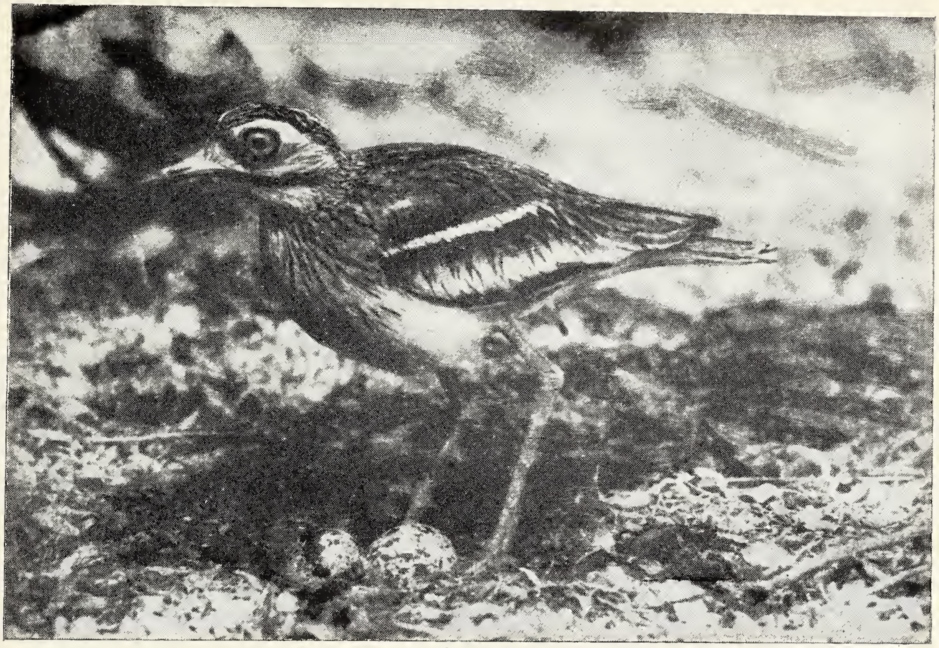
The following are observations on the nest we first found on August 1st—

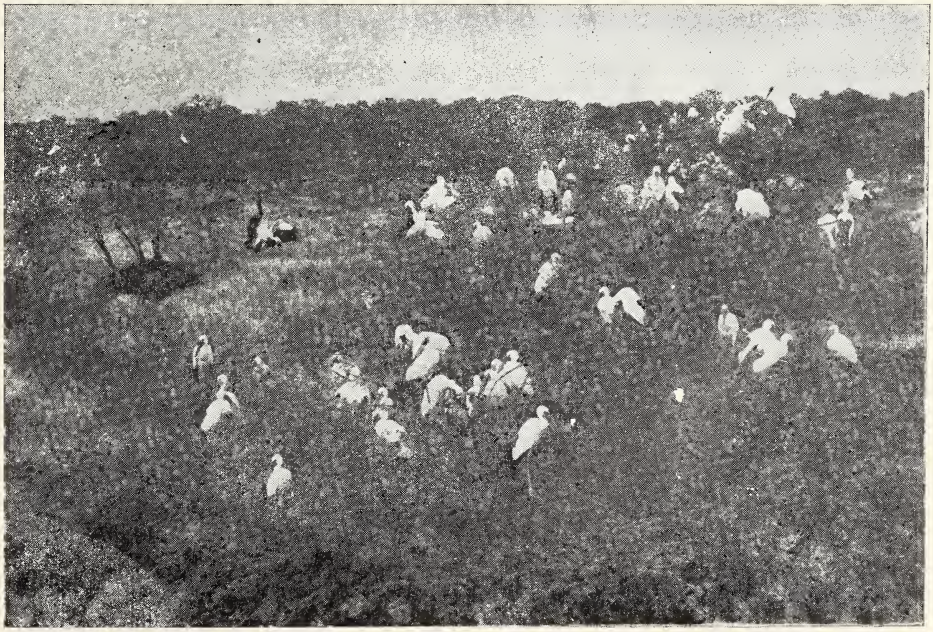
25th August, 1980. One egg had disappeared from the nest.

28th August. Checked the nest at 8.32 hours and two eggs were pipping. Stayed in the blind overlooking the nest till 12.25 hours. During that time the bird rushed off the nest twice to distract a House Crow that had perched in a babul tree about 30 metres away. In each case the jacana took off with such force that an egg rolled off the nest. When it returned the bird rolled the egg back onto the nest with its beak. Like the Pheasant-tailed Jacana, this species scoops the eggs underneath itself with its wings when settling down to incubate.

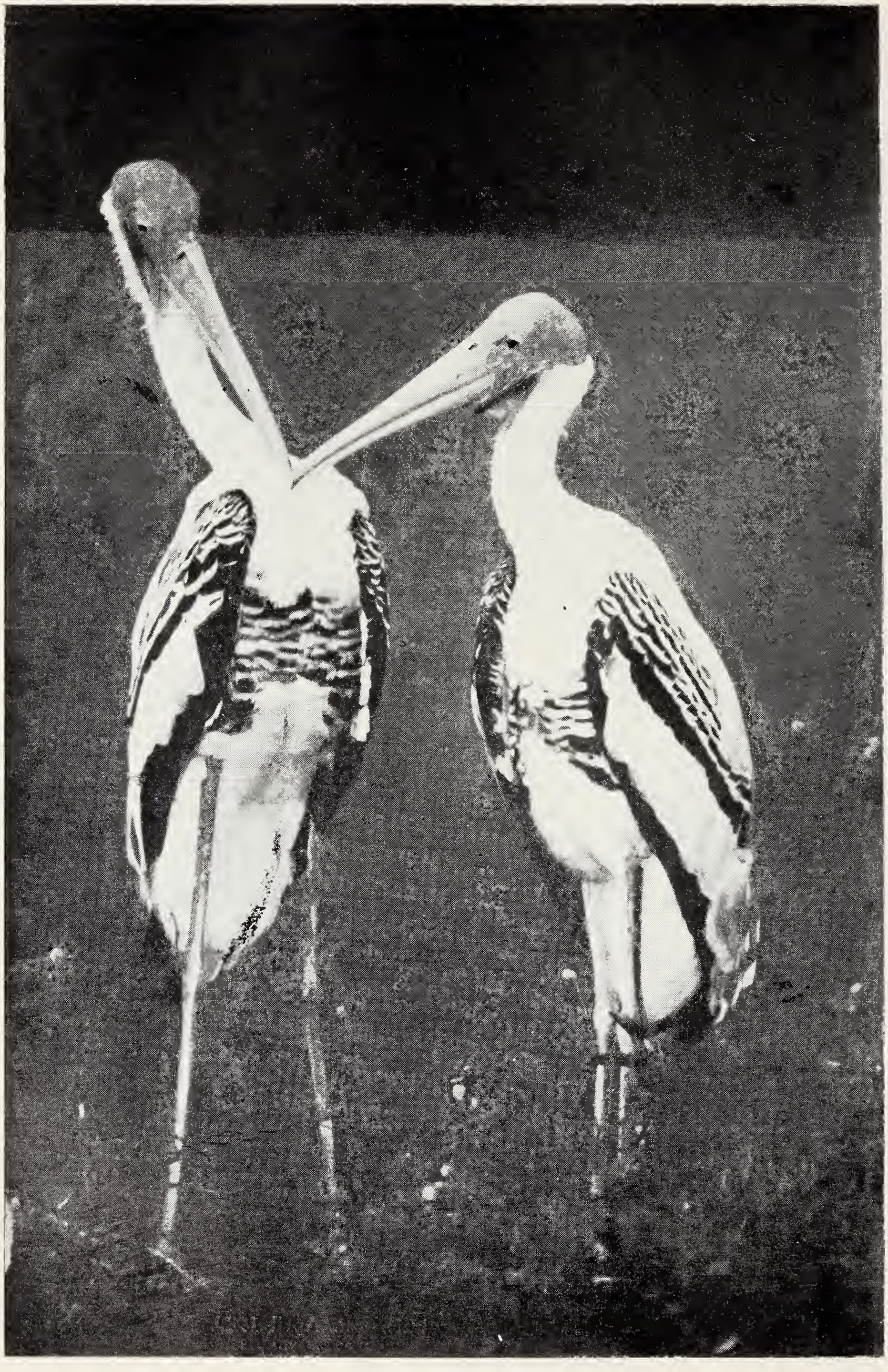
29th August. Arrived at the blind at 6.00 hours. The bird did not get off the nest as I entered the blind. The bird gave a call we had not heard before, a very soft "preeow, preeow" with the beak barely opened. The eggs had not yet hatched at 6.20 hours. We went back to the nest at 8.15 hours and found that one egg was nearly ready to hatch, we could hear the chick peeping. Perhaps the adult's new call was in response to the peeping of the chick. The chick hatched at 8.37 hours. The sitting bird, presumably the male, raised himself slightly and the hatchling tottered towards him and while still wet pushed underneath one of the adult's wings, lodging between his body and the wing. At 8.53 hours the male stood up, gently opened his wing and dropped the young, he ate a few small fragments of egg shell and took the larger pieces of shell away. When he returned the chick squirmed back under one of the male's wings. The male called softly all the while and held his wings slightly open. The male left the nest four more times before 10.14 hours when we left the blind. Each time the young was gently dropped and each time the adult returned it struggled back under one of his wings.

30th August. Arrived at the blind 6.04 hours. At 6.07 hours the jacana stood up briefly, the long pink legs and feet of a chick dangled from under each wing. The third egg had not yet hatched. At 6.15 hours the male suddenly flew off the nest dropping the two young. One landed in the water where it stayed "frozen" until the parent returned at 6.22 hours, then both young rushed to him and pushed one under each wing. At 6.31 hours the male tucked the egg under himself. From 6.39 hours onwards the adult no longer sat on the egg but rested on his tarsi when on the nest. The young occasionally squirmed out from under the male's wings and foraged around the nest. Three times in quick succession the male rushed off the nest end, screeching loudly chased another, larger Bronzewinged Jacana, presumably a female. At 8.40 hours the male ran off taking a young under each wing with him. The male stood on floating aquatic plants about six metres from the nest. At 8.46 hours the male dropped the young to chase another BW Jacana. Two minutes later he returned and the young pushed under his wings, then he dropped them again and they foraged around the adult's feet. By 9.33 hours the adult brought the chicks back to the nest, but did not sit on the egg again. At 10.43 hours he walked off the nest, carrying the two





Above: Stone Curlew at its nest. April 1980.
Below: Openbill Storks nestbuilding. July 1980.
(*Photos*: Stanley and Belinda Breeden)



A pair of Painted Storks preening each other during courtship. August 1980.
(*Photo*: Stanley and Belinda Breeden)

young and did not return to the nest. On inspection the third egg turned out to be infertile.

When in the blind, using close focusing binoculars, we were able to examine the colours of the adult's lappet and beak. The colours are as in figure 1. The lappet is entirely pale blue-grey with a triangle of red on the upper mandible. This we found to be the case with all Bronzewinged Jacanas we saw right up to the end of January 1981. Most bird books, Ali & Ripley (1969), King *et al.* (1975) and Woodcock (1980) show or describe the lappet as being completely red.

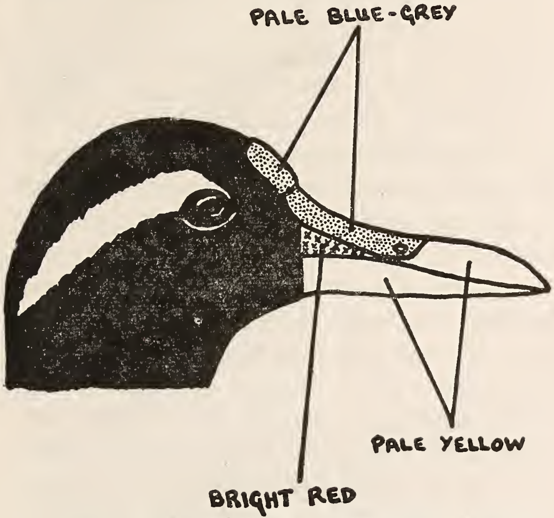


Fig. 1. Head of male Bronzewinged Jacana, *Metopidius indicus.*
Beak: pale yellow, duller towards tip. Lappet: pale blue-grey. Triangular area at the base of the upper mandible: bright red.

Vanellus indicus

REDWATTLED LAPWING

We found the first nest of this species on a mound in Ram Bund on 19th April 1980. It contained four eggs. We found another nine nests between that date and June 27th but none after that. A nest we found on May 14th was situated on the baked, hot, bare earth of Hans Sarovar Bund very close to Keoladeo Temple. The shade temperature during that day and the next three fluctuated between 42°C and 45°C. The temperature out in the full sun and on the bare earth must have been considerably higher. On May 14th the nest contained three eggs. The next day there were four. On May 17th we observed the nest from 10.45 hours to 13.00 hours. The birds changed over at the nest at 10.55 hours, at 11.42 and then at 12.42 hours. That meant they sat for periods of 47 and 60 minutes out in the sun. While sitting the birds panted constantly with feathers fluffed out, except when Black Kites wheeled overhead when the birds would sleek their feathers, stop panting and press close to the ground. The relieving bird walked cautiously and slowly all the way from the bund, 150 metres away, over the cracked soil to the nest. The bird on the nest would not rise till its partner was only a few paces away, then it stood up. The new arrival then slipped on to the eggs while the other stood shading them. The relieved partner walked a few paces and then flew to the southern edge of Cirra Bund close to the Keoladeo Temple where there was a small amount of water. The birds arriving at the nest had invariably wet the feathers of their undersides.

The nest we found on June 27th was in babul woodland just north of Ram Bund. It was washed away in a torrential downpour in the early hours of August 11th when virtually the whole Sanctuary was under 15 centimetres of water.

Tringa erythropus

SPOTTED REDSHANK

This species was present in small numbers throughout the winter and spring. The last one we obeserved was a bird in breeding plumage seen near Pump D on May 5th 1980.

Rostratula benghalensis

PAINTED SNIPE

The first bird noted was a female near Pump D in Cirra Bund on April 14th 1980. On April 26th there were three pairs in Ram Bund. By May 11th many birds were calling in the green areas in Cirra Bund and Ram Bund. Observed a pair from a blind on May 14th. They were in short green grass growing in about six centimetres of water. The female was busy for about 15 minutes pulling blades of grass together as though building a nest. But no nest was built. Numbers continued to increase until there were about 90 to 100. In one small muddy puddle at the edge of Ram Bund there were 14 of these birds, ten of them females. This was on May 23rd. Once the rains came and the marshes began to fill we saw no more of them. We did not find any nests, though we did search for them.

Recurvirostra avosetta

AVOCET

Saxena (1975) rates the Avocet as rare. During November, December 1979 and January 1980 small numbers, never exceeding 12, stayed for extended periods. The birds invariably came to the muddy pool in the centre of Cirra Bund. By the end of November this area was totally devoid of vegetation and the muddy edges attracted wading birds in large numbers.

Burhinus oedicnemus

STONE CURLEW

On April 25th 1980 Abrar Khan showed us the nest of a Stone Curlew in woodland between the Tourist Bungalow and Ram Bund. The nest was under a piloo bush. In late April and early May the birds were very vocal throughout the Sanctuary, calling mostly at dusk. We were shown other nests near Cirra Bund (1st May), at Python Point (10th May) and at Bakalaya beside the main road (15th May). All nests contained two eggs and were under piloo or babul shrubs in woodland.

At 5.30 hours on May 13th we noticed the eggs in the nest we were shown on April 25th were pipping. We observed the nest from a previously erected blind from 6.30 onwards. At 8.32 hours the first chick hatched. It soon dried. The parents changed over twice between 8.32 hours and 10.32 hours when we left. They did not stay at the nest together. As soon as one arrived the other left. At first the chick was ignored. The sitting parent picked up and ate small fragments of eggshell but the large pieces of shell they tucked under themselves and brooded them together with the young and the second egg. Finally at 9.52 hours one parent flung the empty shells away but only about half a metre from the nest. It did not pick the shells up and carry them away.

On the afternoon of May 15th Abrar Khan showed us yet another nest (i.e. the fifth nest) in woodland near Shanti Kutir that had two pipping eggs. The young hatched that evening.

On May 23rd in the early morning we saw a pair of Stone Curlews with a single downy chick near the main road at the turnoff to Python Point. While we were watching a mongoose trotted close by. Both parents successfully distracted the mammal by doing a dribbling, running broken-wing act.

Larus argentatus

HERRING GULL

On January 16th 1980 two of these gulls were in Cirra Bund near the Keoladeo Temple feeding on a dead fish. This species was not noticed again.

Larus ichthyaetus

GREAT BLACKHEADED GULL

On April 18th 1980 a single individual of this species landed in Ram Bund. On April 19th it was joined by another four which were changing into breeding plumage. On the morning of the 20th they left.

Larus brunnicephalus

BROWNHEADED GULL

Twenty-four Brownheaded Gulls in full breeding plumage landed in the north-west corner of Rauji Bund 1 on the afternoon of April 19th 1980. They left the next morning.

Pterocles exustus

INDIAN SANDGROUSE

Abdulali and Panday (1978) note this species as occasional and Saxena (1975) considers it rare. From January to early June 1980 this species came regularly and in some numbers to drink at Ram Bund and the area round Pump D at Cirra Bund. At first the birds came in twos and threes but by late April they were coming in flocks of 50 or more. On May 15th we saw scores of these sandgrouse feeding in the grassland just north of Kola Dehar.

Treron phoenicoptera

GREEN PIGEON NBR

Green Pigeons were seen in the Sanctuary in some numbers. We found three nests, one on 2nd May, 1980, one on 11th May and one on 25th May. Each was in a babul tree at a height of about 12 metres. Saxena (1975) does not record this species as breeding in the Sanctuary.

Streptopelia sp.

DOVES

Three species, *S. decaocto, S. tranquebarica* and *S. senegalensis* breed in Bharatpur. *S. decaocto* and *S. senegalensis* began nesting in late March 1980 and stopped at the end of May. We saw several pairs of *S. tranquebarica* collect and carry nesting material (only around the eastern end of Ram Bund) in April, but we found no nests with either eggs or young in the pre-monsoon period. In late May and June these doves moulted and then began nesting again in the second half of August and continued to October. In the monsoon and post-monsoon breeding *S. tranquebarica* began earlier. We found the first nest on 29th July 1980. The other two species' first monsoon nests were found on 13th August. Many pairs of *S. decaocto* nested in the babul trees in the heronries and we observed several nests from positions where our blinds were set up to photograph egrets or storks. On August 24th a House Crow took eggs from beneath a sitting bird. The crow boldly approached the nest, even though the dove beat at it with its wing. The crow ignored the battering and grabbed an egg. A short time later it returned to take the second egg.

S. decaocto nested at heights between three and six metres while all the nests of *S. senegalensis* we found were in thorny shrubs at heights between one and two metres.

Clamator jacobinus

PIED CRESTED CUCKOO NBR

We first saw this species on June 15th 1980 (we were absent from June 1st to 14th). On the morning of June 24th we observed a pair mating in the trees around Keoladeo Temple. On July 12th a party of five Jungle Babblers was feeding a fledgeling Pied Crested Cuckoo.

The fledgeling was mostly brown, dark above, pale below and already had a well-defined crest. On July 16th along the bund just west of Shanti Kutir we observed a party of five Jungle Babblers feeding two Pied Crested Cuckoos. At dusk the whole party huddled closely together, babbler style, to settle down for the night. Saxena (1975) does not list this cuckoo as a breeding species for Bharatpur.

Cuculus canorus

CUCKOO NR

Neither Abdulali and Panday (1978) nor Saxena (1975) list this species for Bharatpur. Between June 22nd and 26th 1980 there was a great influx of Common Hawk-Cuckoos and Cuckoos into Bharatpur. The majority of them, about 25 of the two species combined, stayed in the babul trees along the western bund of Ram Bund. During these days the Cuckoo was seen and heard frequently.

Cacomantis merulinus

PLAINTIVE CUCKOO NR

This is another cuckoo not previously recorded for Bharatpur. On June 26th 1980 we saw an hepatic female or immature of this species in the woodland immediately to the west of Shanti Kutir.

Centropus sinensis

COMMON CROW-PHEASANT

During the winter and spring this species was largely a scavenger. We saw it feeding on stranded fish, a dead coot, a dead roller, turtles killed by Scavenger Vultures and on one occasion on a Crow-Pheasant which had been killed on the main road.

Otus bakkamoena

COLLARED SCOPS OWL NBR

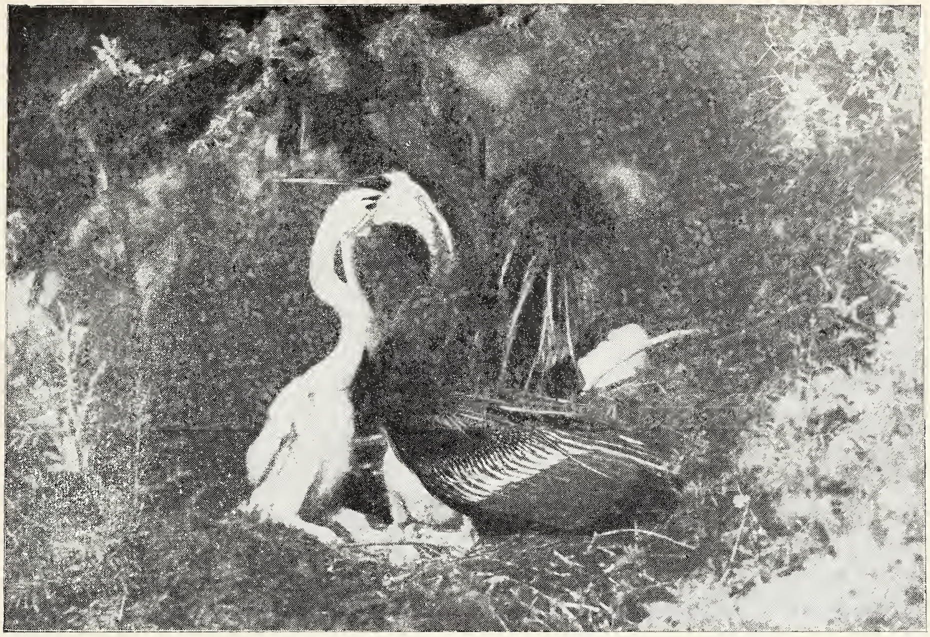
We first saw this species in a hollow in a huge babul tree on 24th November 1979. The tree was on the eastern side of the main road about one kilometre south of Shanti Kutir. The pair had occupied this hollow for some years (Abrar Khan; pers. comm.). We saw the pair regularly until 14th April 1980 when we noticed the hollow had been taken over by bees (*Apis* sp.). On March 3rd 1980 we found a nest in a hollow in a babul tree right beside the Keoladeo Forest Outpost. The hollow, which in previous years had been occupied by rollers (Abrar Khan, pers. comm.), was 5½ metres up in the tree. We first inspected the hollow on March 24th when it contained one egg. On April 1st we found a single young, covered in pure white down and about three centimetres in length. By April 27th the young was sitting at the nest entrance. Between 28th April and 1st May we observed the birds from a blind for several hours each evening. The young would be at the nest entrance by dusk. Shortly after dark one of the parents would come with food at which time the young would clamber out of the nest-hole and sit on a nearby branch. By morning the young was back in the hole, but the parents roosted in the foliage of a neem tree about ten metres from the nest. Of the prey brought to the young by the parents we could identify (from photographs) centipedes, moths and mole-crickets. One of the parents had orange eyes, those of the other were dark brown.

The appearance of the birds during the day, when they were roosting, was very different to what they looked like at night. During the day they sat fluffed out, their eyes were slits and their "ear" tufts very pronounced. At night their heads appeared more rounded with only a vestige of "ear" tufts visible.

Bubo sp.

HORNED OWLS

Three species, *B. bubo, B. coromandus* and *B. zeylonensis* occur in the Sanctuary, *B. bubo*



Above: Darter feeding young. September 1980.
Below: Bronzewinged Jacana carrying young under its wings. August 1980.
(*Photos*: Stanley and Belinda Breeden)

Above: Kadam tree with nest of Ringtailed Fishing Eagle after it had burnt down. February 1980.

Below: Cirra Bund at the height of the drought—May 1980. Some water had been pumped into the area and in the distance Sarus Cranes can be seen standing in the shallow pools.

(*Photos*: Stanley and Belinda Breeden)

and *B. coromandus* in remarkably large numbers for such a small area. *B. zeylonensis* is a rare visitor and we did not see it. The Dusky Horned Owl, *B. coromandus,* seems to be the more common and roosts almost invariably in groves of tall kadam trees. These groves extend in an arc from just west of Ram Bund, to the nursery then down along the eastern boundary to Kadam Kunj. There is also a grove at Lal Payare Ka Kund. At night these owls range the forests and the tree-lined bunds surrounding the marshes. During the monsoon we frequently saw them in and around the heronries on moonlit nights.

The Great Horned Owl, *B. bubo,* is confined to the drier and less accessible parts such as Python Point, areas to the south of it and the Deer Park, where we saw them frequently. Once, on 11th July 1980 we saw a Great Horned Owl in scrub beside the main road just south of Shanti Kutir.

Strix ocellata

MOTTLED WOOD OWL NR, NBR

We first saw this species in the Sanctuary on November 17th 1979. This was the first time it had been positively identified in the region. We saw it in the beam of a powerful spotlight along the bund about half a kilometre west of Sapan Mori. On November 23rd we saw three of these owls at dusk in a eucalypt tree on the southern edge of Bharatpur city, about two miles from the Sanctuary.

On March 5th 1980 Abrar Khan showed us the nest of a Mottled Wood Owl in fairly dense, dry scrub in the western portion of the Deer Park. The nest was situated in the lowest crotch of a large neem tree, at a height of just over four metres. There were two eggs laid directly in the tree crotch. There was no nesting material whatever. The female, larger, bird was sitting. The male sat higher up in the neem tree in a dense patch of foliage. Abrar Khan, who had been unable to identify the bird, told us he had found a nest of this species in this same place for the first time in 1974. He observed them there every year since then with the exception of 1979. (The birds nested there again in February/March 1981. Abrar Khan, pers. comm.). On March 29th 1980 we checked the nest and found one small young and one egg. By April 12th the larger chick was lightly feathered. The feathers on its chest and back were almost white at the tips but suffused with rufous at the base and finely barred in black. The smaller chick was still covered in down. At dusk the male and female called to each other —the female's call is a resonant "kroo", the male's is the same but of higher pitch and more scratchy.

On April 15th we watched the nest at night from a towerblind. At 21.20 hours the female came and fed the young on a juvenile Magpie Robin (identified from photographs). The female fed the chicks very small pieces of the prey. The young were not fed again before 23.30 hours when we left the blind. On the night of 16th April the female first came to the nest at 19.45 hours. She brought a large, still-squirming centipede which she tore into small pieces and fed to the young. At 23.06 hours a wood owl called—a far-carrying, quavering "kro-oo-wah"—the bird called three times. The parents did not come to the nest again before we left at a few minutes after midnight. On April 17th both birds arrived near the nest at 19.57 hours and called to each other. The young responded with mewing sounds. A few minutes later the female landed on the nest and fed the young on a small insectivorous bat. On April 18th both parents arrived and landed on a thick branch about four metres from the nest at 21.35 hours. They called vigorously to each other in "kri kri" and "kroo kroo" calls. The male had brought a Roseringed Parakeet and was devouring it. The female begged food from the male and he gave her a small piece, which she took to the nest and fed to one of the young. Ten times she fed the young this way—the larger chick receiving eight pieces, the younger one two. Finally the female got a leg of the parakeet, flew to the nest and fed it whole, complete with feathers, to the smaller chick. The female then thoroughly cleaned the nest, swallowing several feathers of prey species in the process. She flew off at 22.23 hours and did not return before 23.10 hours when we left. We examined the feathers of the parakeet plucked by the male and scattered at the base of the tree. The parakeet's primaries and retrices were still partly enclosed in their sheaths which suggests that, like the Magpie Robin, it was a fledgeling, On May 5th we found one fledged owl and both parents in the neem tree, though not on the nest. We could find no sign of the second young.

We saw a single Wood Owl in a kadam grove at Syar Mori on May 23rd.

Caprimulgus indicus

JUNGLE NIGHTJAR

This species was calling everywhere in the Python Point area during April and early May 1980. On April 27th, by using a spotlight, we found a pair with two young just SW of Python Point. The young, already well feathered, were huddled together on the sand; there was no sign of a nest. The next day we searched the area by daylight but could not find the young, though we did find one of the young again that night with the aid of a spotlight.

Alcedo atthis

SMALL BLUE KINGFISHER

Normally this species is resident at Bharatpur all year round and nests there between March and June. In 1980 this species disappeared from the Sanctuary in early March and was not noticed again until 15th June.

Halcyon smyrnensis

WHITEBREASTED KINGFISHER

This kingfisher, while present in small numbers throughout the drought, did not nest in spring, as it usually does. But on June 22nd, when the humidity increased and a few premonsoon showers had fallen, we noticed two pairs excavating nest-tunnels in the banks of the pond opposite Keoladeo Temple. When the Sanctuary was flooded in the second half of July these nest-tunnels were inundated. On June 22nd we also saw a pair of these birds with three fledgelings at Ram Bund which had remained filled with water. This was the only record of this species nesting successfully in 1980.

Coracias benghalensis

INDIAN ROLLER

During January 1980 we found five dead rollers in various parts of the Sanctuary. Other visitors also reported finding many dead individuals. The ones we found were emaciated. On March 5th we noticed the first aerobatic courtship displays of the roller. We found one occupied nest in a large hollow in a jamun tree near Agar Gate on April 15th. Usually this species nests in some numbers during March and April (Abrar Khan, pers. comm.) but the nest at Agar Gate was the only one we found that spring. Courtship flights continued throughout the summer.

We found that a pair of rollers had begun nesting in a hollow in the babul tree near the Forest Department Outpost at Keoladeo where they had nested many seasons before. There were two eggs on June 15th. This was the same hollow in which a pair of Collared Scops Owls raised a single young in March/April. We found another roller's nest on June 22nd. Both nests were later abandoned when they filled up with water after heavy rain on June 28th and 29th.

Megalaima haemacephala
CRIMSONBREASTED BARBET

The nesting season for this species appeared normal and we saw a number of nests during March-April. We closely observed a nest near the Keoladeo Temple. It was in a babul tree at a height of about 2½ metres. About 15 metres away stood a large pipal tree which was fruiting. Over the two weeks we watched the parents feed the young in the nest we saw them bring food other than pipal fruit on only two occasions. On both occasions they brought a large dragonfly.

Pitta brachyura
INDIAN PITTA

Saxena (1975) does not list this species for Bharatpur and Abdulali and Panday (1978) note it as "occasional". We saw an Indian Pitta on June 28th 1980 in a jamun thicket just SE of the watchtower.

Ammomanes phoenicurus
RUFOUSTAILED FINCH-LARK NBR

Saxena (1975) does not record this as a breeding species. We observed one collecting nesting material on April 2nd 1980 in the dry area between Ram Bund Road and the Tourist Bungalow.

Sturnus roseus
ROSY STARLING

Rosy Starlings are passage migrants at Bharatpur. We observed the first parties on the outward passage on March 24th 1980. They were present in considerable numbers from that day till April 26th. They fed on the piloo berries which were present in profusion.

We saw the first birds on the inward journey on July 30th. This was a small party of 11 birds including several young ones. On August 1st there was a flock of 400-500 birds roosting in a big tree near Shanti Kutir.

Tephrodornis pondicerianus
INDIAN WOOD SHRIKE

On June 30th 1980 we found a nest with two eggs in a small bush west of the Tourist Bungalow. When we checked the nest on July 12th we found it deserted and with a stout shoot from the shrub growing through the middle of it.

Pycnonotus cafer
REDVENTED BULBUL

On August 20th 1980 we found a nest of a Redvented Bulbul about 1½ metres up in a babul in the Ram Bund marsh. The nest contained five eggs. This seems an unusually large clutch. According to Vijayan (1980) a clutch size of more than three eggs has not been recorded for *P. cafer*. Perhaps clutch size varies between subspecies. According to Ali and Ripley (1971) *P. c. cafer,* which is the subspecies occurring in Vijayan's study area at Point Calimere in Tamil Nadu, has a clutch size of two to three eggs. For *P. c. humayuni,* which is the subspecies at Bharatpur, the same authors record a clutch size of three to four eggs.

Terpsiphone paradisi
PARADISE FLYCATCHER

This species was not seen in Bharatpur by us during the winter months. Our first sighting was on March 25th 1980, an adult male. We further sighted this species on March 30th, April 10th, April 15th, May 14th and June 19th. We always saw single individuals.

Phoenicurus ochruros
BLACK REDSTART

This redstart is a common winter visitor. Numbers in the Sanctuary began to decline in early April and our last record for the season was May 15th 1980. This was of a female with an injured leg. From April 13th onwards all our sightings were of females only. The first redstart we saw in autumn was a male, it was seen on September 27th.

Salpornis spilonotus
SPOTTED GREY CREEPER NBR

We first noticed this species on April 19th 1980, a single individual foraging on the trunks of babul trees on the eastern edge of Ram Bund. On June 28th we observed a pair building a nest in woodland between Shanti Kutir and the watchtower. The nest was built at a height of about six metres and was attached to a fork in a dead branch. We watched the pair build for the next two days. But after several days of heavy rain the nest was abandoned. This is the first breeding record for Bharatpur for this species.

Petronia xanthocollis
YELLOWTHROATED SPARROW NBR

Saxena (1975) does not record this sparrow as breeding in Bharatpur. But during March, April and May we found scores of nests. The nests were always in small tree hollows at a maximum height of four metres.

Ploceus manyar
STREAKED WEAVER BIRD NBR

This species is not recorded as breeding in the Sanctuary. During the monsoon several vigorous colonies were active in the reeds of Ram Bund.

Lonchura punctulata
SPOTTED MUNIA NBR

On July 21st 1980 Abrar Khan showed us a nest of this species in a babul tree near the watchtower. During the next month we saw this species building nests in and around the heronry at Rauji Bund 1. On September 26th we observed a pair building their nest inside that of a Painted Stork. This too is a new breeding record for the Sanctaury.

Lonchura malacca
BLACKHEADED MUNIA

On June 25th 1980 we saw three of these munias on a colony of Streaked Weaver Birds in Ram Bund. Saxena (1975) does not record this species for Bharatpur and Abdulali and Panday (1978) list it as a stray.

Emberiza buchanani
GREYNECKED BUNTING NR

On April 18th 1980 we saw a single individual of this species in dry open woodland with a grassy understory in the Deer Park. Neither Saxena (1975) nor Abdulali and Panday (1978) list this species for Bharatpur.

ACKNOWLEDGEMENTS

We are greatly indebted to Abrar Khan for sharing his many interesting observations and his great knowledge of the Sanctuary with us.

Ronald T. Sauey and The International Crane Foundation kindly gave us data on cranes and Romulus Whitaker identified the various species of turtles.

We are grateful to The Regional Meteorological Centre, New Delhi, for supplying the rainfall figures for Agra shown in Table One.

We wish to especially thank the US Fish and Wildlife Service for supporting us in the field and subsequently while preparing this paper.

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BOMBAY NATURAL HISTORY SOCIETY

The Builders and the Guardians

Part 3

SALIM ALI

(*With two plates*)

[*Continued from Vol.* 78(2):239]

JOHN WILLIAM YERBURY, LIEUT. COL. 1847-1926 (Vol. 32: 786) Anon.

Born March 30, 1847 at Serampore (Bengal) knocked down and killed by a motor car on November 10, 1927 at the age of 80. He served in the Royal Artillery between 1868 and 1892 in various parts of the world and was stationed for many years in Aden where he made considerable collections of mammals, birds, reptiles, butterflies and moths, flies (Diptera) and sea shells, which he eventually presented to the British Museum, and in all of which he was keenly interested. He was well known to ornithologists from his papers on the birds of Aden published in *The Ibis* for 1886 and in *JBNHS* for 1897. Col. Yerbury was one of the earliest members of BNHS being on the rolls in 1886 when the Society issued its first *Journal*. His most important contributions to it are:

'The Butterflies of Aden and Neighbourhood with some notes on their Habits, Food plants, etc.' (Vol. 7: 207).

'A list of the Birds of Aden' (Vol. 11: 75).

After retirement his chief interest appears to have been confined to Diptera on which he wrote several valuable papers.

His appeal for assistance in collecting gad flies, bot flies and warble flies (Vol. 13: 683) contains some very useful instructions for collecting this group of insects.

OLDFIELD THOMAS, F.R.S. 1858-1928 (Vol. 33: 966) by M.A.C.H.(inton).

Born February 21 at Millbrook, Bedfordshire, U.K., died 'in tragic circumstances' (?) on June 16. From early boyhood he developed a marked taste for Natural History and decided to become a Naturalist. On leaving school he started life as a clerk in the office of the British Museum and voluntarily devoted his leisure to zoological studies under the great Huxley for a couple of years. He was transferred to the Zoology Department of the Museum in 1878 and later placed—willy nilly at first because his real interest was Echinoderms—in charge of the Mammal collection, a position which he held for 45 years, till his official retirement in 1923. By diligence, thoroughness and industry he worked up and published in 1888, the Museum Catalogue of Marsupialia and Monotremata which remains to this day the solid foundation of all systematic work on the groups. Thomas soon gathered around him a band of enthusiastic voluntary workers in the Museum. One of the great secrets of his success in enlisting private help for the execution and financing of his collecting projects, lay in the promptitude with which he worked out and published accounts of the material collected, from which benefactors saw immediate results. He worked with amazing rapidity and had the gift of seeing the essentials of any problem that came to him for solution, and of getting to the point in the shortest way while never forgetting anything of real importance. In 1897 Thomas became fortuitously acquainted with R. C. Wroughton, a Conservator of Forests in Bombay Presidency, then on leave in England and working in the Mammal Room of the BM on a collection of bats he had made in the Surat and Thana districts. These were worked out with the help of Thomas who described them in *JBNHS* (Vol. 11 : 274). Thus started the close personal friendship between these two men which proved the real genesis of the Society's epoch-making Mammal Survey of India, Burma and Ceylon. Wroughton, supported and advised by Thomas, urged the Society to undertake the Survey "of which any Society or Government in the world might well be proud."

In working out the scientific results from the Mammal Survey Miss Kathleen V. Ryley of the B. M. gratefully acknowledges the help and advice she received throughout from Mr Oldfield Thomas. During his career as a mammalogist, Thomas described over 2000 species and more than 200 genera, including several from India. His papers are models of terse description with nothing superfluous anywhere; indeed, often he might have said a little more with advantage. People who knew him only by his writings were inclined to regard him as a narrow systematist, but in fact Thomas was essentially a field naturalist and on his various journeys made important collections of mammals in addition to invertebrates. His dedicated labours have built the unrivalled collection of mammals in the British Museum and the vast literature relating to it.

GEORGE MICHAEL RYAN, I.F.S. ...—1932 (Vol. 35: 879) Anon.

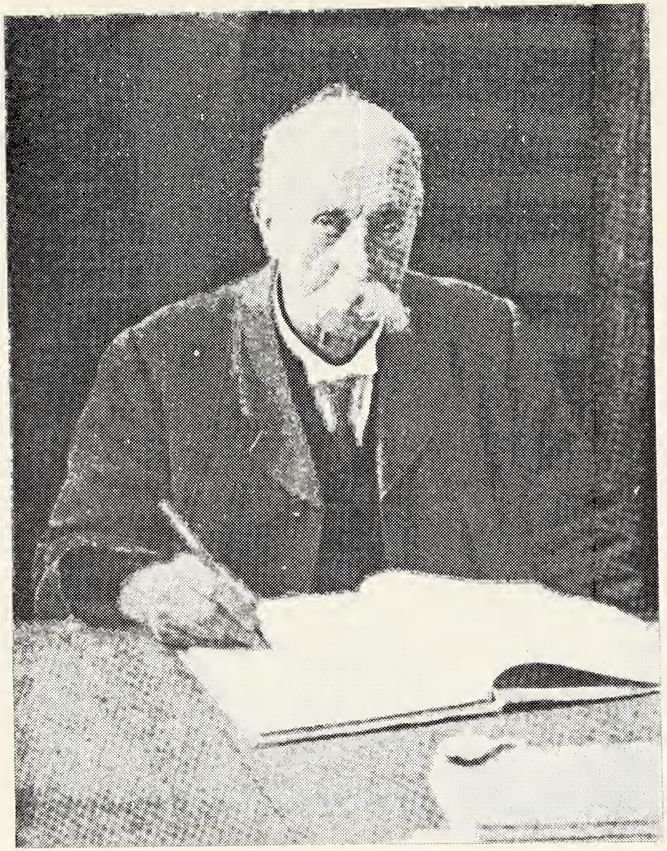
Was in the Bombay Presidency cadre of the Indian Forest Service from 1883 to 1914, and an old member of the Society. He was widely known for his researches and the practical application of his scientific knowledge to the preservation and improvement of old trees. The authorities at Kew recognised his expertise, and after his retirement in England, frequently referred to him for advice inquirers from all parts of the country. During his residence in India Mr Ryan contributed a number of notes to the Society's *Journal* mostly of botanical interest. Among these are the papers on Edible wild Yams as Famine Foods (Vol. 14: 772 and Vol. 15: 721) and the Water-yielding Plants of the Thana forests (Vol. 16: 65).

THOMAS BURGESS FRY 1850-1931 (Vol. 36: 225—photo) by R. I. P. (ocock).

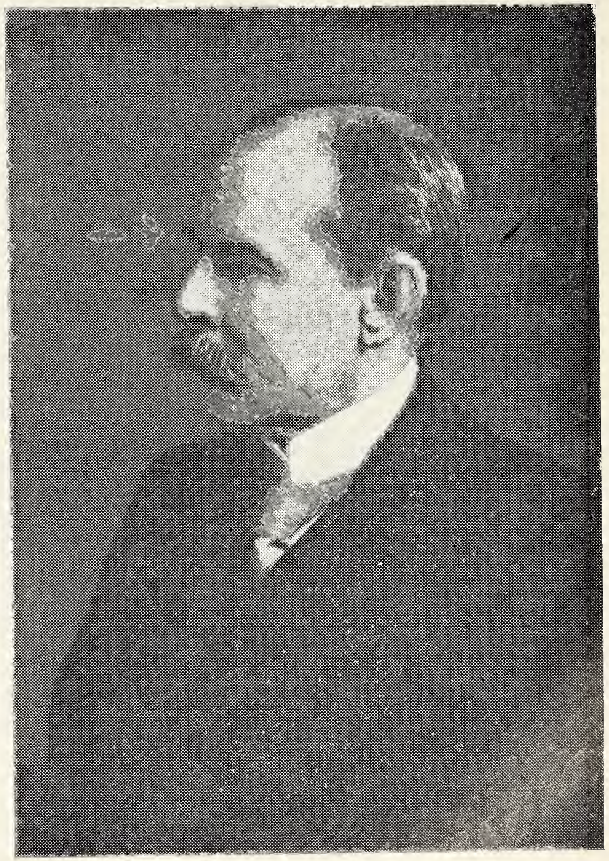
Born at Crowsborough, Sussex, U.K. on July 8, 1850, died on November 20, 1931 aged 81. Fry served in the Indian Forest Service (Bombay Presidency) till his retirement in July 1905. Soon thereafter, he joined his brother-in-law, R.C. Wroughton, then working at the Natural History Museum, London, to help him in sorting, cataloguing, identifying and subsequent dispersal to various museums, of the vast collections of mammal skins and skulls being received by the Museum. He had had no formal zoological training and all his knowledge of mammals was what he had acquired as a sportsman during his service in India. Yet by diligent application during his apprenticeship with Wroughton, he had developed the necessary technical knowledge for identifying the species, even to the extent of learning the structural details of the skulls and teeth of obscure groups like bats, shrews and mice, by the time the vast collections of the Society's Mammal Survey commenced reaching the British Museum in 1913. To the great majority of our older members C. B. Fry will only be known as the joint author, with M.A.C. Hinton and R.C. Wroughton, of several reports published in *JBNHS* of the Mammal Survey collections. He had acquired such professional expertise, that when Wroughton died he carried on the task often single-handed, putting in 6 hours of work on 5 days in the week with short breaks only for the summer holidays. In his younger days he was an accomplished athlete and sportsman, and he kept up his interest in games and sports to the last. In his later years, he indulged actively only in golf and it was actually while in the middle of a round that he suddenly collapsed and died on the course. Only a few days before his death he had handed over to Mr Hinton, for revision, his report on the Mammal Survey collection from the Eastern Ghats which coincidentally also happened to be the last of the regular series from the Survey's field work.

A. W. ALCOCK, LIEUT. COL., I.M.S., F.R.S. 1850-1933 (Vol. 36: 726—photo) by B. P. (Baini Prashad).

Though trained as a zoologist in Aberdeen University, Alcock first came out to India to teach Classics in Darjeeling and then worked as an assistant on one of the Bihar plantations for several years before competing for the Indian Medical Service which he entered in 1885. After 1888 he was selected for the post of Surgeon-Naturalist to the Marine Survey of India and in 1893 succeeded J. Wood-Mason as Superintendent of the Indian Museum, a post which he held up to his retirement in 1907. On return to the U.K. thereafter, he worked as a lecturer in Medical Entomology in the London School of Tropical Medicine and ended up in 1924 as Professor of Medical Zoology in the University of London. Perhaps Alcock's most important contribution to Indian zoology lies in the original researches he carried out while Surgeon-Naturalist on the survey ship 'Investigator', reported in the *Journal of the Asiatic Society in Bengal* (JASB) from 1890 onward, and in the *Proceedings of the Royal Society of London*. Among the 50 or more papers on marine zoology that Alcock published up to the time of his retirement from the Indian Museum in 1907, those on deep sea fishes and crustacea deserve special notice. Besides systematic accounts of various marine animal groups, he published a number of papers on viviparous fishes, on "An Instance of Natural Effect of Warning Colours on the toxic properties of Saliva in certain Colubrine Snakes", "On a new Flying Lizard from Assam", "An Account of the Reptiles collected by the Afghan Boundary Commission", and "On a new apodous Amphibian from India" in the *Annals and Magazine of Natural History* and elsewhere. The last paper includes a learned discussion on the changes in the configuration of the various continents as deduced from the distribution of the limbless amphibians. In 1905 Col. Alcock developed a special interest in Entomology, particularly in the different forms of insects incriminated as disease-carriers. His *Entomology for Medical Officers* published about 1911 is a very well conceived and lucid text book of tropical



Thomas Burgess Fry
(1850-1931)



A. W. Alcock
(1850-1933)

Ethelbert Blatter, S.J.
(1877-1934)

zoology. Though working under frustrating conditions as Superintendent of the Indian Museum, he did very valuable work in carrying out salutary reforms in the general management of the institution and arrangement of exhibits in the public galleries, the latter, often largely prepared with his own hands. At the same time he published a number of handy and interesting guide books in order to popularise the Museum and make the exhibits understandable by the lay public. His book, A NATURALIST IN INDIAN SEAS, published in 1902, is a classic of continuing relevance. While in Calcutta, he was intimately associated with the Asiatic Society of Bengal and most of his scientific publications were either in the JASB or in *Annals and Magazine of Natural History.* His only two articles in JBNHS are "Deep sea life in the Bay of Bengal" (8: 545) and "An instance of the natural repellant effects of 'Warning Colours" (11: 149). Col. Alcock died on March 24, 1933. Though not connected directly with the affairs of Bombay Natural History Society, his presence in India as Superintendent of the Indian Museum and as Naturalist of the survey ship 'Investigator' was in many ways of considerable benefit to the Society during its formative years.

ETHELBERT BLATTER, S.J., 1877-1934 (Vol. 37: 466) by C. McC(ann).

Born in an aristocratic family in Switzerland on December 15, 1877; Joined the Society of Jesus in October, 1896. Died in Poona on May 26, 1934. In 1903, during the interval between his philosophical and theological studies in Austria and Holland, Blatter came to India for the first time. Botany had been his hobby from his early years; as a boy he could name almost all the plants of his native hills "not only by sight but also by taste". Later, as a mature scientist, although he had acquired equal proficiency in Zoology and Geology, he elected to concentrate on his first love, Botany —a subject in which he was to win international renown. He joined St Xavier's College as Professor of Biology soon after his arrival in India in January, 1904. About this time he also joined the Bombay Natural History Society and remained one of its most active and helpful members till the end of his days, not only by his scientific contributions in the *Journal,* but also in the Society's administration as a member of the Executive Committee and as a Vice President. Fr Blatter was a man of weight and substance [*c.* 250+ lb!] not only physically but also for the influence he carried in the governmental, educational and scientific circles of his day. By the time he returned to Europe, in 1909, to complete his ecclesiastical studies, he had acquired a deep knowledge of the flora which marked him out as a leader in the field of systematic botany of the Indian Region. After being ordained as a priest in 1912 he spent a year in Holland and then some time in special studies in London. He was a frequent visitor to Kew Herbarium, and the close liaison he established there with the leading botanists of the time stood him in good stead in his work in India. He was still in London in 1914 when World War I broke out, and it was with some difficulty that he eventually managed to reach Bombay in October, 1915 on a Japanese ship, through the Suez Canal and Turkish rifle fire. On his return, Blatter once more assumed the professorship of Biology in St Xavier's College and launched the extensive collecting forays in every part of the country which have resulted in making the St X. C. Herbarium (later named after him) one of the finest in India. In 1919, he was appointed Principal of the

College, but though administrative duties and responsibilities as a member of the Bombay University Senate hampered his scientific activities considerably, he nevertheless continued to function as Professor of Botany. In 1925, he retired to Panchgani as parish priest, and this left him freer to pursue his botanical studies. In 1930, while on a collecting expedition in Waziristan he had a bad fall from his horse and suffered a slight concussion of the brain and a mild paralytic stroke. Though he recovered sufficiently to carry on his intramural botanical work for the next three years, his health had begun to fail from that time and he died in Poona on May 26, 1934. In recognition of his *'Conspicuously important contributions to the knowledge of Asiatic Botany'* Fr Blatter was awarded the Johannes Bruehl Memorial Medal of the Asiatic Society of Bengal, a distinction which he greatly valued.

Fr Blatter was a ceaseless and indefatigable worker and a prolific multilingual scientific writer. His papers on systematic botany are classical and have earned him international fame. But above all he was a Biologist, and though specializing in systematic botany, he was equally interested and proficient in zoology. He was a great believer in field work and the study of ecology, and always liked to poke fun at "the deep thinkers who never returned to the realities of creation". From the long list of publications appended to his obituary in JBNHS Vol. 37, I have picked out a few titles at random to show that besides learned, purely scientific papers—'dry as dust' as the layman would call them—he was capable of discoursing on many other interesting natural history topics in a way that the layman can readily comprehend.

The Fauna and Flora of our Metallic Money. 16: 334-39 (1905).

Flowering Season and Climate. 17:334-50 (1906).

Caterpillars as Ants' Pets. 18:591-95 (1908).

History of the Sea Coconut. 19: 925-37 (1910).

Scorpion Sting and Garden Rue. 24: 839-43 (1916).

Oleander Poisoning Camels. 26: 306-9 (1918).

Luminiscence in Plants and Animals. 31: 748-53 (1926).

What Age can a Tree reach? 34: 594-97 (1930).

Fr Blatter's most important books with a popular appeal are: The Palms of British India and Ceylon. (Oxford University Press, 1926).

Beautiful Flowers of Kashmir. [John Bale, Sons & Danielsson. London. Vol. 1. (1927), Vol. 2 (1928)].

Some Beautiful Indian Trees, with W. S. Millard. Bombay Natural History Society, 1937.

As a biology teacher, Fr Blatter was extremely thorough, painstaking and patient and quick to discern who, among his students, was genuinely earnest and who merely a degree-seeker. For the former he would spare no pains in channelling and developing their special aptitudes, as his many former students who are front line botanists today will readily testify. Other admirable attributes about the man were his infectiously cheerful presence, his friendly humanity and his unfailing sense of humour with the rare capacity to sometimes laugh at his own expense. His obituarist narrates that, while in England, Blatter worked for some time as Chaplain to the dowager Duchess of Sussex. "He used to relate with loud laughter how the noble lady was wont to apportion him a single slice of meat which she carved in truly ducal manner from the daily shoulder of mutton. She considered this ample fare, for an obviously overnurtured Jesuit. Unable to agree with her judgement of his capacity as a good trencherman, Blatter, unknown to the Duchess, was compelled to go to the local inn to supplement Her Grace's ration with more generous if more plebian fare." Fr Blatter was also wont to relate, with much puckish amusement, an experience he once had in Calcutta while riding in a ramshackle hack 'tikka gharry'—a primitive box-like contraption on wheels drawn by a pair of bony rat-sized ponies—when the floorboards suddenly gave way underfoot and he found himself on the road shuffling along behind trying to keep up with the ponies. His agonized shouts brought the 'gharry' to a halt and the coachman down from his seat to investigate. "With a surprised expression" the portly Fr Blatter recounted "the man first looked at me, then at the splintered footboards, then more meaningfully again at me, as if suspecting some connection between the two"!

Francis James Mitchell 1855-1933 (Vol. 37: 475) Anon.

Better known among his friends as Frank Mitchell. Born in Scotland, he came out to India at the age of 18 to join his brothers in a contracting and brokering business at Cawnpore (Kanpur). With his brothers he was concerned in many pioneering enterprises in the country including the building of the Bengal-Nagpur Railway and the Jhelum Valley road from Kohala to Srinagar. Among his many other pioneering achievements was the establishing of an olive plantation at Kahire Murat near Rawalpindi, and a 400 acre fruit farm in the newly canal-colonized Montgomery district (now in Pakistan) known as Indian Mildura Fruit Farm Ltd.—one of the largest fruit farms in the Indian subcontinent. In Kashmir, where he developed a lucrative export trade in carpets, he employed his leisure largely in pheasant rearing and fish culture. It was Frank Mitchell who first conceived the idea of introducing trout into Kashmir; he helped to found the Kashmir Trout Fishing Club and managed to obtain for them trout ova while on a visit to England. After a poor start and a second attempt, the ova eventually hatched out at Harwan, and the Dachigam river was stocked. He established hatcheries at Harwan and Achibal and supplied the stock for most of the Kashmir rivers and lakes. Mitchell trained the local men in trout culture and taught them the work from spawning to the distribution of yearlings. His story of how trout were introduced into Kashmir is published in the *Journal* (36: 295). One of the many things he did for Kashmir, which country he loved dearly, was to induce his friend Fr Blatter to write the *Beautiful Flowers of Kashmir* and financed its publication. Two volumes were published in 1927 and 1928 and a third was being considered when the plans were unfortunately cut short by the death of both author and sponsor. Frank Mitchell was an old and valued member of BNHS; he is described as a genial lovable man who had endeared himself to all with whom he came in contact, for besides his many abilities 'he possessed just those qualities which endear the best type of Englishman to the Indian villager'.

A. J. W. Milroy, I.F.S., 18..-1936. (Vol. 39: 376) by N.L.B.(or).

A Conservator of Forests in Assam, he is best remembered for his work in the cause of game preservation and for introducing a new method of elephant hunting which revolutionized the brutalities practised in Assam up till 1920 or so. He also succeeded in putting an end to the far-flung rhinoceros poaching, financed by unscrupulous wealthy traders, which had brought the animal to the verge of extinction in the Kamrup and Kaziranga Game Sanctuaries. Prior to 1920, the hunting of elephants in Assam was in the hands of the Assamese and Kampti mahaldars. The methods they employed involved the most unheard of cruelty to the animals. A herd was driven from a salt-lick into a stockade built nearby or along one of their own paths astride it. The animals were left in the stockade for anything up to a fortnight or even three weeks until they had been weakened sufficiently by hunger and thirst to be safe, as the native mahaldars believed, for the *koonkies* to be entered into the stockade. The condition of the animals after the lapse of such a period was beyond belief and cannot be imagined by anyone who has never seen it. The interior of the stockade would be littered with the carcases of the calves killed by hunger, thirst or being gored by maddened tuskers; the tails of the rest would have been bitten off. The picture of those left, with sides fallen in, heads down and mouths open with blackened tongue protruding and covered with filth and blood, would be a sight never to be forgotten. In this condition when the wild elephants would be too exhausted to give any trouble in the stockade, the sleek well-fed *koonkies* would be marched in and the captives noosed and dragged out. “Any attempt to regain their freedom was promptly dealt with by the *phandies* who slashed open the skin at the back of the neck where the noose fitted, and rubbed some sand into the wound”. No veterinary aid was given with the result that all abrasions went septic and the most appalling maggot-infested wounds were a commonplace. Casualties during training, also by the most inhuman methods, were as high as 48 per cent, and for the entire period, till the animals were fit for service, as much as 80 per cent! Milroy’s methods revolutionised elephant hunting in Assam: in the two years of training, casualties were reduced to 1 per cent, and the total casualties, to not more than 3 per cent. No elephant was to be left in a stockade more than 72 hours and no spears were to be taken into a stockade for prodding the animals. It was characteristic of the man that he rode a *koonkie* into the stockade that housed his first catch to prove to the doubting *phandies* that the unstarved wild elephants could be taken out without a single scratch. At the depot a trained veterinarian was always present to attend to any wounds twice a day. “No spears were allowed and anyone who used one got a lambasting with the handle thereof.” Milroy’s methods of catching and training humanely and in shorter time proved a complete success and are now accepted as the only methods to be followed in Assam, “and woe betide the Assamese mahaldar whose casualties exceed the prescribed minimum.” His knowledge of elephants and of jungle life generally was such that few Europeans acquire. His articles in the *Journal* on Elephant catching in Assam (29:80) and on the Preservation of Wildlife in India (Assam) (37: 97-104, Supplement) are highly interesting and informative and amply substantiate this claim. When elephant hunting Milroy was indefatigable; he drove with the drivers or acted as doorkeeper at a stockade, or as one of the stops, and often bestrode an elephant like a phandie while training it. In fact he knew the business from A to Z.

Among other benefits, his methods proved to the mahaldars that elephants could be trained in a very short time: that casualties in the training depot could be reduced to negligible proportions: and that an elephant trained by a mixture of firmness and kindness was in every way superior to a broken-spirited animal trained according to the former brutal methods. Milroy was a man possessing a wonderful personality and a singular charm of manner, and with a great sense of humour. He was hero-worshipped by the junior officers and subordinates of the Assam Forest Service. He died on September 26, 1936.

FREDERICK VICTOR EVANS 1865-1940 (Vol. 42: 431) Anon. (Editors)

Came out to India in 1886 and with a partner founded (in *c.* 1892) the prosperous department store of Evans, Fraser & Co. in Bombay, himself retiring from active business to England in 1908. During his later years in Bombay, Evans found recreation in *shikar* about the Thana Creek and nearby districts and he was fond of camp life and sailing and fishing in the Harbour. His practical support to the interest of local fishing clubs, led to the development of the Lonavala lakes belonging to the Tata Hydroelectric schemes as possible fishing areas. His active interest in BNHS seems to have begun some years later; he was elected a Vice Patron in 1928 in recognition of the very generous financial assistance and support which he gave to the Society. His several substantial contributions were chiefly utilised for the exhibition galleries of the Natural History Section (Prince of Wales Museum), then under construction. And harking back to his fishing days in India, when he had difficulty in getting his catches identified, he maintained at his own expense for over a period of ten years the services of a modeller for the preparation of a series of casts of local marine and freshwater fishes for the Fish Gallery. The beautiful models of local fishes in wax and *papier maché* now on exhibition in the P.W. Museum are the outcome of his altruistic benefactions since he himself was unlikely ever to see them. Mr Evans also presented to the budding Museum the series of beautiful and expensive enlarged models illustrating insects in relation to disease. The Society's *Journal* profitted by his magnanimous offer to meet the cost of many of the coloured and black-and-white plates for the serial on 'Wild Animals of the Indian Empire' and the illustrations for Mr Mosely's lengthy serial on Caddis Flies. In addition, he gifted to the Society's library a collection of rare and valuable old books of Bombay and Western India and a complete set of the 7 elephant folio volumes of the priceless Gould's *Birds of Asia,* and a copy of *A Century of Birds of the Himalayan Mountains* by the same author. Mr. Evans had no children; "he lived a very retired life in England, and if there is any meaning in the term 'Spiritual Home' his certainly was in India, which he loved very much."

MAHARAO SHRI KHENGARJI OF KUTCH 1886-1942 (Vol. 43: 242) by S. H. P. (rater).

Succeeded to the gadi of Kutch at the age of 10 and ruled the State with sagacity and statesmanship for close on 60 years. Maharao Khengarji enjoyed high esteem among his compeers in princely India as well as from the British Indian Government. "He loved no ostentation or display. But his stately courtesy and charm of manner invested him with a natural dignity which impelled respect". The Maharao was an exceedingly observant and knowledgeable field naturalist and sportsman—especially a big game hunter. His association with BNHS went back almost to the year of its foundation, his name already appearing among the list of members published in Vol. 2 of the Journal in 1887. He maintained a keen personal interest in the affairs of the Society throughout the years; was elected a Vice President in 1921 and became a Vice Patron in 1924. Maharao Khengarji has the distinction of being the first to report the breeding of the Flamingo in India in 1893, following this up later with a note and supporting photographs in the *Journal* 'Breeding of Flamingo in the Rann of Cutch' (Vol. 15: 706). The data provided in this note enabled the Society 43 years later to send an expedition to the Great Rann to collect the material for the beautiful diorama of the flamingo nesting colony exhibited in the Prince of Wales Museum. The entire cost of the expedition as well as of the museum exhibit was donated by the Maharao. The information collected by the expedition forms the basis of the leader, Mr McCann's excellent seminal article on "The Flamingo (*Phoenicopterus ruber antiquorum*" in *JBNHS* 41: 12-38, which marked the beginning of many subsequent study expeditions to the Rann by other naturalists.

(*To be continued*)

PHAYRE'S LEAF MONKEY (*PRESBYTIS PHAYREI* BLYTH, 1847) OF TRIPURA[1]

R. P. MUKHERJEE[2]

(*With a text-figure*)

This paper deals with the abundance, distribution, social structure, food and feeding behaviour of Phayre's leaf monkey of Tripura. During the survey of north, south and part of the west districts a total of 36 groups containing 409 Phayre's leaf monkey were seen. Out of the 36 groups, 35 groups were bisexual and one was an all male group. The paper includes the ecology of the study areas and a list of food plants and the feeding behaviour of the monkey.

INTRODUCTION

Phayre's leaf monkey (*Presbytis phayrei* Blyth, 1847) which is restricted in its distribution to the state of Tripura in India is poorly known. Agrawal (1974) Agrawal and Bhattacharya (1977) studied its taxonomy and briefly described its distribution. Green (1978) in his report on "Primates of Bangladesh" reported the occurrence of this money in a few areas of Bangladesh adjacent to Tripura. In his preliminary survey of population and habitat of monkeys in Bangladesh he has recorded the Phayre's leaf monkey from the regions of Sylhet and Chittagong. The present study shows that this monkey is widely distributed in Tripura. The surveys carried out by Green in Bangladesh and by me in Tripura revealed that this species is more widely distributed in Tripura than in Bangladesh.

I had the opportunity of visiting Tripura twice and studying this little known colobid monkey in its natural habitat. During the months of November-December, 1976, a survey of the south and part of the west districts of this state was conducted. The second survey was carried out in the months of May-June, 1978, in the same two districts and also in the north district with an idea to cover the area as much as possible and to collect information on the abundance, distribution and ecology of the monkey. The last trip was also utilised to collect information on the abundance of rhesus monkey in the south district of Tripura. This paper deals with the abundance, distribution, social structure, food and feeding behaviour and the relation of this species with other species of monkeys that are found in the study area.

The monkeys that were observed in the various forests of Tripura during these two surveys were rhesus macaques (*Macaca mulatta*), stumptailed macaques (*Macaca speciosa arctoides*), hoolock gibbons (*Hylobates hoolock*), capped langurs (*Presbytis pileatus*), Phayre's leaf monkey (*Presbytis phayrei*) and slow loris (*Nycticebus coucang*). Mukherjee (1977) has published a brief note on the rhesus and other monkeys of Tripura.

Agrawal (1974) studied the taxonomy and discussed the status of *P. phayrei* and *P. barbei*. His study was based on the specimens

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[1] Accepted November 1980.

[2] Zoological Survey of India, Calcutta.

mainly collected from Tripura. The colour of the body of Phayre's leaf monkey is dusky grey with golden or pale buff on the back. The head is of the same colour as that of the body except back and erect brow hairs. A well defined crest is found over the head only in freshly killed specimens. The whiskers are long and partially conceal the ears. Areas around eyes are naked and milky white. The lips are also milky white and studded with sparse white hairs. Fur on the ventral side is silver white and fore and hind limbs are of same colour as that of body except black dorsum of hand and foot. The tail is paler than body and has a tuft of blackish brown hairs at the tip. In males the area below pubic callosities is light grey but it is yellowish in females (Agrawal 1974). In the field it can easily be recognised even from a distance by its colour around eyes and lips.

STUDY METHOD

Field studies were mainly conducted in the winter and summer months. During the last part of the second survey there was heavy rain as monsoon had set in. The surveys were conducted in forests, villages, towns, temples and cities. The observations were mostly carried on foot and on vehicle. In the second survey a vehicle was used, and an elephant was used in surveying parts of Garjee forest in the south district during the first survey. Most of the surveys were carried out from dawn to dusk. The methods that were used to locate the groups were road side, transect and point census. In the forest the procedure adopted was to move slowly with least noise and stop every half-kilometer for ten minutes and scan the area thoroughly. The transect method was carried out usually with two observers in each party.

Once a group was observed the notes on the group size and composition, habitat, food and feeding behaviour, its interaction with other species of monkeys, etc. were taken. Besides this, some groups were selected for extensive study of their food and feeding behaviour. The mechanical aids which were used in the field studies were binoculars and still camera with a telephoto lens of 200 mm was used.

The monkeys that were not weaned were usually carried by the mothers during group movements and were classified as infants. The monkeys which were independent of their mothers were grouped as juveniles.

No attempt was made to follow all the groups for long distances. In most of the groups it was possible to study them at close quarters and it was feasible to observe the activities of the groups from a distance of 30 m. In groups which were not shy, it was possible to study by sitting under the trees on which they were feeding or resting. However, the only difficulty that was faced on such occasions by the observer was that if the group was scared due to the presence of the observer the dominant male gave loud barks and most of the monkeys started to urinate and defecate. This not only interfered the normal activity of the group but also disturbed the observer.

Ecology of the study area: Tripura (23° 50′ N, 91° 15′E) is situated at an altitude of about 338 m. The configuration of the land is mostly hilly, gently undulating or flat. There are two main hill ranges in the southern division namely Barmura — Deotamura and Tekkatulshi. These two hill ranges are parallel to each other and run north to south. In the flat lands there are many low hillocks locally known as tillas. Many rivers and their tributaries criss-cross the flat lands. Almost all the flat lands are put to agricultural use and the cultivations have extended into the valleys between the hillocks, and the continuity of the forest is broken.

The hills, which are clayey, appear to be of recent origin, mostly belong to tertiary age and are related to Surma and Tipan series. The soil is formed by the disintegration and weathering of these rocks. The soil is generally sandy loam to loamy sand or clayey loam to pure clay. Its colour mostly varies from grey to brown. The soil in the forested areas is generally loamy sand. It is practically without humus. The soils of the state have been classified into three broad soil types. They are alluvial, red and yellow soils. The ash produced by the annual forest fire is washed down into the cultivated fields in the valleys.

The climate is tropical and the tropic of Cancer passes through this state. It is generally hot and moist and there are three distinct seasons: summer, rains and winter. The high temperature in summer, which lasts from March to May, is tempered by occasional rains. The monsoon starts from June and continues upto October. Pre-monsoon showers are also common in the month of May. The winter lasts from November to February.

The average maximum and minimum temperatures recorded were 29.15°C and 15.50°C respectively. The maximum and minimum temperatures recorded were 35.75°C and 8.25°C in the year 1954 and 1950, respectively. The highest and lowest temperatures are usually reached in May and January respectively. Almost the entire rainfall is received during the monsoon but summer and winter rains are fairly common. During winter, at times, mild frost occurs in low lying areas. The average rainfall is about 1582 mm. The maximum humidity recorded so far was 100%, and the minimum 42%. The average humidity usually varies from 68% to 71%. The highest humidity is reached in the month of July. The winter is severe and is characterised by the fall of dew. The various rivers and streams form the main source of water supply. The forests of this state belong to the moist tropical type and they can broadly be divided into tree and bamboo forests with open scrub jungle and grasslands. The composition of the forests varies from place to place and these can be grouped into Sal forests, (*Shorea robusta*), garjan forests (*Artocarpus chaplasha*), dense mixed deciduous and evergreen forests, mixed bamboo forests and open scrub forests with thatch and tall grasses.

The principal trees which form the top canopy are *Albizzia procera, Albizzia stipulata, Artocarpus chaplasha, Bursera serrata, Careya arborea, Garuga pinnata, Gmelina arborea, Lagerstroemia parviflora, Lannea grandis, Schima wallichii, Shorea robusta, Sterculia villosa, Syzygium cuminii, Terminalia bellirica, Vitex peduncularis, Stereospermum* and *Machilus* species. The middle storey is generally composed of *Careya arborea, Dillenia pentagyna, Lagerstroemia parviflora, Mallotus philippensis, Premna bengalensis, Shorea robusta, Bridelia, Machilus* and *Wrightia* species.

The undergrowth consists of *Coffea bengalensis, Clerodendron, Eupatorium, Flemingia* and Thatch. These undergrowths are usually thin in the flat areas and on the gently sloping hill tops but are thick in moist areas. The climbers that are found in these forests are *Acacia pennata, Bauhinia vahlii, Butea parviflora, Dalbergia stipulacea, Mikania scandens and Millettia pachycarpa.* In the mixed forest the canopy is very much open and broken. The damage to the forests are caused mainly by encroachment, jhuming, illicit felling and fire. Some of the main ecological fea-

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tures of the study area are presented in Table 1.

A total of 409 monkeys were counted in the 36 groups, out of which 73 were males, 169 were females, 92 were juveniles and 75 were infants. The group size varied from 4 to 38. Though smaller number of groups were encountered in the northern district, the biggest group with 38 members was observed here. The group size and composition of different groups are presented in Table 3.

TABLE 1

ECOLOGICAL FEATURES OF THE STUDY AREA

Characters	State of Tripura
Altitude	338 m
Longitude	91°15′E
Latitude	23°50′N
Rainfall	1582.38 mm
Temperature	16.6°-29.4°C
Summer months	March-May
Main monsoon	South-East
Monsoon months	June-October
Humidity	42%-100%
Forest type	Moist tropical (Tree and bamboo forests)
Human population	Dense
Other primates	Rhesus and stumptailed macaques, Capped langurs, Hoolock gibbons and Slow loris.
Possible predators of Phayre's leaf monkey.	Carnivores, Eagles and Pythons.

Group size and composition: Out of the 36 groups of Phayre's leaf monkey that were encountered during the two surveys, 8, 17 and 11 groups were recorded from north, south and west districts respectively (Fig. 1). A total of about 1484 sq. km., 1797 sq. km. and 664 sq. km. of these three respective districts were surveyed. The average group size of the bisexual groups in these three districts were 14.25 (± 3.58), 12.18 (± 1.22) and 8.10 (± 1.12) respectively. The population distribution and social structure of bisexual groups of this monkey in different districts of Tripura are shown in Table 2. Of the 36 groups, 35 were bisexual groups and one was an all male group. The only male group of 7 monkeys was recorded from west district.

A group with one male, one female, one juvenile and one infant that was observed in the west district appears to have been of recent formation. Out of the 35 bisexual groups, 14 groups contained only one male and an equal number of groups contained two males, whereas the 4 and 3 groups contained three and four males respectively. Majority of the groups that contained more than one male, only one was an adult male, the rest were

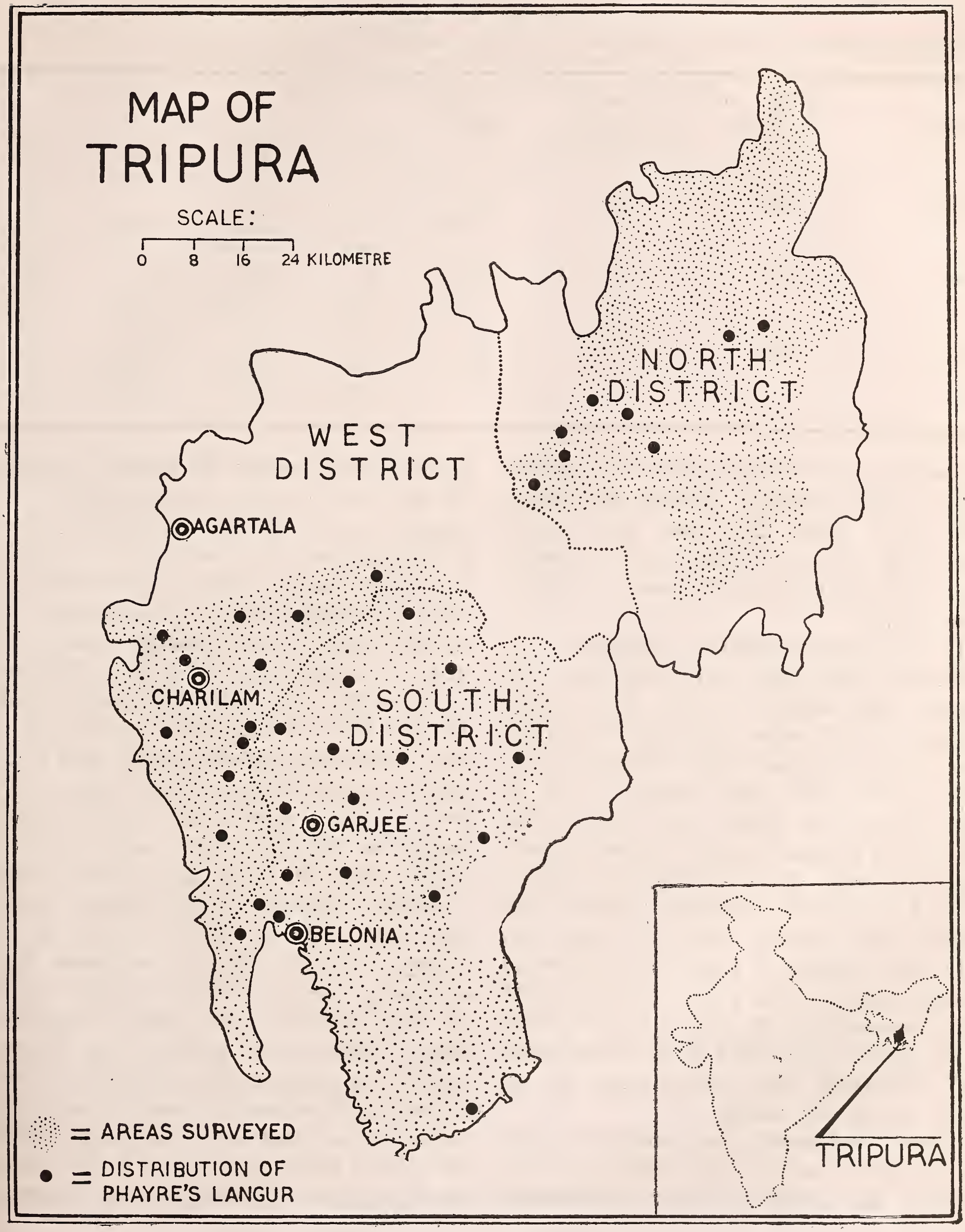
MAP OF
TRIPURA
SCALE:
0
8
16
24 KILOMETRE
NORTH DISTRICT
WEST DISTRICT
AGARTALA
CHARILAM
SOUTH DISTRICT
GARJEE
BELONIA
= AREAS SURVEYED
• = DISTRIBUTION OF PHAYRE'S LANGUR
TRIPURA

Fig. 1. Distribution of Phayre's leaf monkey in the study area.

TABLE 2

POPULATION SURVEY AND SOCIAL STRUCTURE OF BISEXUAL GROUPS OF PHAYRE'S MONKEY OF TRIPURA

Districts	Sq. Km. area surveyed (approx.)	Total number of bisexual groups observed	Average group size	Adult		Sub-adult	
				♂♂	♀♀	♂♂	♀♀
North	1484	8	14.25 ±3.58	13 1.88± 0.35	49 6.12± 1.66	31 3.88± 1.20	19 2.71± 0.57
South	1797	17	12.18 ±1.22	36 2.12± 0.24	88 5.18± 0.56	43 2.69± 0.30	40 2.78± 0.50
West	664	10	8.10 ±1.12	15 1.50± 0.22	32 3.20± 0.51	18 2.25± 0.41	16 1.78± 0.36

sub-adult. In 35 bisexual groups, the percentage of males, females, juveniles and infants were 16.41, 42.04, 22.90 and 18.65 respectively. The sex ratio of adult males to females was 1:2.3 and the ratio of females to infants was 1:0.44.

In the bisexual group no interaction between the adult males and females was observed. The members of the group when alarmed moved inside the forest by leaping from branch to branch thus covering the distance quickly. The daily activity of the all male group was almost the same as that observed in a bisexual group. The males alarm bark was similar to that of the golden langur.

Food and feeding behaviour: Phayre's leaf monkey feeds almost entirely on leaves. On only one occasion a group came close to human habitation and a few members of the group descended on the roof of a house. Most of the groups were found in the mixed forest and occasionally they moved into the sal forest, usually for resting.

Phayre's leaf monkey was observed to start feeding activity shortly after waking up in the morning and continues for a considerable period. During feeding the monkeys remained on the same tree for a long period or frequently moved from tree to tree. The whole group feeds and moves as a unit. The intensity of the feeding decreased considerably at noon, particularly during summer months, but increased again in the evening. Feeding was never a continuous activity and was frequently interrupted by short non-feeding spells during which the individuals either rest or move. Individuals generally caught hold of the nearby hanging twigs and bent them to the level of their mouths and either nibbled directly at the buds, leaves and flowers or plucked them with hands and ate. They usually plucked fruits with their hands. During rains there was considerable decline in the feeding and other activities and when there was heavy rain the monkeys sat high up on the thick branches of the trees for hours together without any activity. The feeding, activity was resumed after cessation of rains. In case the food was in plenty a group remained at one place for a considerable period and spent a major part of its activity in feeding. A group was observed to cover a distance

TABLE 3

GROUP SIZE AND COMPOSITION OF PHAYRE'S MONKEY OF TRIPURA.

Sl. No.	Districts	Male	Female	Juvenile	Infant	Group size	Remarks
1.	S	2	5	3	4	14	
2.		1	6	3	—	10	
3.		3	11	3	2	19	
4		4	7	4	3	16	
5.	O	3	6	3	1	16	
6.		2	3	3	1	9	
7.		2	2	2	—	6	
8.		2	4	2	3	11	
9.	U	2	4	2	2	10	
10.		2	2	1	2	7	
11.		1	3	1	1	6	
12.		4	8	5	8	25	
13.	T	1	4	2	1	8	
14.		3	4	2	—	9	
15.		1	6	3	2	12	
16.		1	6	5	3	15	
17.	H	2	7	2	3	14	
18.	W	1	2	2	1	6	
19.		1	3	2	1	7	
20.		2	2	—	1	5	
21.	E	1	5	2	2	10	
22.		1	5	2	3	11	
23.		2	3	2	—	7	
24.		7	—	—	—	7	All male group
25.	S	3	3	2	1	9	
26.		2	2	—	2	6	
27.		1	6	5	4	16	
28.	T	1	1	1	1	4	
29.	N	4	17	12	5	38	
30.		2	3	2	3	10	
31.	O	1	4	3	3	11	
32.		2	3	2	—	7	
33.	R	2	5	2	2	11	
34.		1	7	4	1	13	
35.	T	1	3	2	1	7	
36.	H	2	7	4	4	17	
	TOTAL	73	169	92	75	409	
Means		2.03	4.69	2.55	2.08	11.36	
Standard error		±0.21	±0.40	±0.36	±0.29	±0.94	
Population composition		17.85%	41.32%	22.49%	18.34%		

of about 402 metres in 3½ hours during winter month of December and during this period the group fed and rested while moving from tree to tree.

Phayre's leaf monkey was never observed to invade cultivated fields whereas the rhesus monkey fed exclusively on paddy when it was ripe, just before harvesting (Mukherjee 1977). The feeding activity of Phayre's leaf monkey was restricted very much to the upper and middle stories but rarely to lower storey. It appears that their water requirements are met from the water content of the food that they eat. I did not notice them drinking water during my study. However, it was observed that they lick the water from the leaves or collected on their bodies after rains.

The food of Phayre's leaf monkey consists of leaves, flowers and fruits of various plants. Table 4 includes the list of food plants and the parts eaten, based on observation during different surveys. The larger and mature leaves were eaten individually by pulling them off the branches. They were not observed feeding on animal food. The wide dispersal of food plants in Tripura helps this monkey to spread widely in this state.

On one evening in the month of June, 1978, an eagle made repeated attempts to pick up a Phayre's leaf monkey in the forest of Chamol Chora in the north district. This group, consisting of 17 monkeys, was busy feeding after sunset when the eagle appeared and first dived at the dominant male. Later the bird made repeated attempts to pick up a juvenile. The group members were observed moving down or to drop from the top canopy to the lower branches and to hide themselves from the bird among the thick foliage.

Relationship with other monkeys: A mark-

TABLE 4

FOOD PLANTS OF PHAYRE'S LEAF MONKEY

Plants	Types of plants	Parts eaten
Artocarpus chaplasha	Tree	Leaves & Petiole
Albizzia procera	Tree	Leaves
Bursera serrata	Tree	Leaves
Careya arborea	Tree	Leaves
Dalbergia stipulacea	Climber	Leaves & buds
Dendrocalamus longispathus	Bamboo	Shoots
Dillenia pentagyna	Tree	Leaves
Dipterocarpus turbinatus	Tree	Leaves
Eugenia jambolana	Tree	Leaves & Fruits
Ficus carica	Tree	Leaves & Fruits
Gmelina arborea	Tree	Leaves
Grewia microcos	Tree	Leaves
Lagerstroemia flos-reginae	Tree	Leaves
Lagerstroemia parviflora	Tree	Leaves
Mangifera indica	Tree	Fruits
Mikania scandens	Climber	Leaves, buds and Flowers
Schima wallichii	Tree	Leaves
Salmalia malabarica	Tree	Flowers
Terminalia bellirica	Tree	Leaves

ed tolerance was noticed when Phayre's leaf monkey came in contact with other species of monkeys. There was not much agonistic behaviour observed within a group. No interaction was observed between this monkey feeding on top and macaques feeding on low branches or on ground below the same tree. On one occasion a group of 25 Phayre's leaf monkeys and a group of 18 rhesus monkeys were observed feeding close to each other in Abhoya forest in South district and finally when both the groups moved in the same direction and emerged at one point on the same tree, both the groups gave vocal threats and then retreated in the opposite directions. Not much interaction was noticed between this species of monkey and the other two species namely, hoolock gibbons and capped langurs, that shared the habitat and food with the Phayre's leaf monkey. The capped langurs were observed feeding on the same type of food that was taken by the Phayre's leaf monkey. On many occasions it was observed that the capped langurs feeding close to Phayre's leaf monkey without any agonistic behaviour and their home ranges also overlapped extensively.

On Dec. 3, 1976 in Garjee forest of the south district a male capped langur was observed in association with a group of Phayre's leaf monkey. The Phayre's group, consisting of 2 males, 3 females, 3 juveniles and 1 infant, was quite tolerant to this capped langur. Out of the two males one was sub-adult and the capped langur occasionally chased the sub-adult male and the juveniles, but the dominant male of the Phayre's group defended the group members and chased out the capped langur. This capped langur was observed in association with the group for two consecutive days. On the third day the group moved into the thick forest of the valley and was not traceable.

On May 30, 1978 in a forest of north district, located 16 km from Ambasa on the Ambasa-Manu road, a male Phayre's leaf monkey was observed in association with a group of rhesus monkeys. The rhesus group consisting of 48 members was quite tolerant of the Phayre's monkey. When first seen this monkey was observed in the centre of the group sitting on the top of a tree and feeding on its leaf, whereas the members of the rhesus group were busy feeding on the ground below and on the low branches of the trees.

DISCUSSION

Little is known about the ecology and behaviour of Phayre's monkey. Blanford (1888-91) stated that this species is found in the dense, high and bamboo forests of Burma. Fooden (1971) reported its occurrence in evergreen forests about 15-50 m above ground level in Thailand. Green (1978) recorded this species in the secondary and primary forests of Sylhet and Chittagong in Bangladesh. The survey conducted in Tripura revealed that this species is widely distributed in this state. It inhabits mixed forest and occasionally forays into sal forests. On a few occasions it was observed that they select sal trees for roosting at night.

Blanford (loc. cit.) recorded group sizes of 20-30 animals in Burma. Fooden (loc. cit.) observed groups of 3 to 30 monkeys in Thailand. Green (loc. cit.) in six sightings observed 35 Phayre's leaf monkey in Bangladesh. The group size of 4 to 38 was observed in the survey conducted at Tripura. The all male group, which is a frequent occurrence in the hanuman langur, appears to be less common in the Phayre's monkey. Though some of the bisexual groups contained as many as 4 males the occurrence of 1 to 2 males was more common. Most of the groups had juveniles and infants. Phayre's leaf monkey and capped langur were observed feeding close to each other thus they are sympatric in distribution. This was also observed by Green (loc. cit.) in Bangladesh. Leaves form the bulk of the food of Phayre's monkey in Tripura and this supports the observation of Fooden (loc. cit.). However, they were also found feeding on the petioles, flowers, buds, fruits and bamboo shoots at Tripura. Green (loc. cit.) has also observed these monkeys feeding on bamboo shoots and stems at Bangladesh.

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A BOTANICAL TOUR TO PANGI & TRILOKNATH IN THE UPPER CHENAB[1]

U. C. Bhattacharyya and B. P. Uniyal[2]

(*With two plates and a text-figure*)

The paper presents an account of exploration of a remote N. W. Himalayan valley along a pilgrimage route in the intersection of Lahul and Pangi valleys. Apart from highlighting its main features of vegetation, botanical wealth and physiography, the paper also enumerates a list of 235 species under 54 families, particularly collected in the upper Chenab, with short ecological notes including 62 species hitherto unreported from the Lahul valley.

INTRODUCTION

Most of the approachable river valleys in the Western Himalaya have more than one religious centre visited by people from time immemorial inspite of natural hazards and physical discomforts. One such famous shrine of Triloknath (also spelt Trilokinath) is situated in the upper Chenab valley. The easiest route to reach the area is through the picturesque Lahul valley after crossing the Rohtang Pass (3980 m). During July and August, 1971 we undertook an exploration tour to the upper Chenab for collecting specimens for information on the Botany of the area hitherto little known through published literature. With the inclusion of the Pangi valley as an area for the conservation of wild life, the exploration report of this botanically interesting area was felt to be of considerable importance.

Chenab valley in Lahul is known as 'Manchat' or low land or low valley (Aitchison 1868) and locally this is also called as Patan valley. It is the most thickly populated area in Lahul with extensive cultivated lands and preserves, dense forested areas and herbaceous greeneries (Randhawa 1959) unlike any other part of the dry and desolate Lahul & Spiti valleys. The journey along the valley to Triloknath and further west to Udaipur, presents soothing landscapes of the winding Chenab with green villages and multicoloured network of cultivated terraced fields. The beauty of the valley is further enhanced by the dark green *Pinus wallichiana* and *Picea smithiana* on the north facing slopes and with contrasting yellowish green *Juniperus polycarpos* covering the opposite slopes of the magnificent mountains standing on both sides of the river valley. After a bleak and rugged mountainous feature of the Chandra valleys a journey along the Chenab brings joyous relief to trekkers and botanical explorers.

TRILOKNATH

Triloknath is situated at a distance of about 42 kilometres downstream along the Chandra-Bhaga or Chenab from Tandi. Only very recently the Chenab valley up to Udaipur has been connected by motorable road where

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[2] Botanical Survey of India, Northern Circle, Dehra Dun.

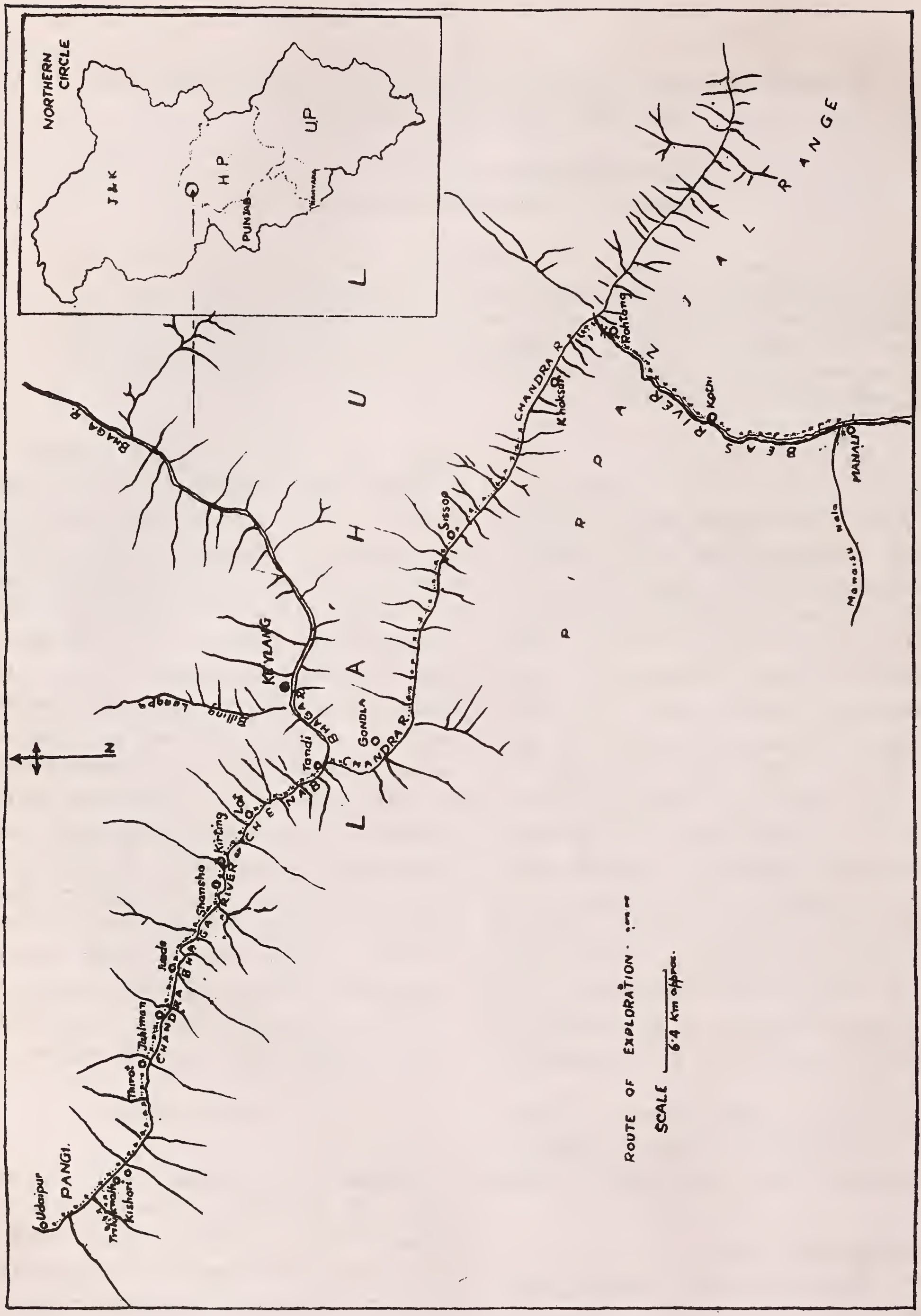

NORTHERN CIRCLE
J & K
H.P.
UP
PUNJAB
HARYANA
L A H U L
P I R P A N J A L R A N G E
BHAGA R.
KEYLANG
Billing
Tandi
GONDLA
CHANDRA R.
Sissoo
Khoksar
Rohtang
Kothi
B E A S RIVER
MANALI
Manalsu Nala
C H E N A B RIVER
Kirting
Lot
Shansha
Jahlman
Rande
Kishori
Triloknath
Udaipur
PANGI.
N
ROUTE OF EXPLORATION
SCALE
6·4 Km approx.

Fig. 1. Route map of the area explored.

buses are regularly plying to the close vicinity of Triloknath and people can reach the place without facing much difficulty. The small white temple of the shrine stands at the edge of a precipitous rock and the surrounding panorama from a distance reveals a pictorial view of the snowclad mountains in the background and a vast extension of the Chenab with large winding course disappearing into the great wilderness of the snowy heights. The mountain slopes facing north above Triloknath subtend beautiful forests of *Pinus wallichiana* and *Picea smithiana* up to the visible limit and end in complete barrenness predominated by a reddish carpet of *Polygonum affine* above 3500 m. On the farside of Triloknath the valley appears quite rugged with pale green *Juniperus polycarpous,* sparsely covering the eroded slopes. Down at the bottom, the colourful terraced fields of Kishori village are visible. The latter is thickly populated and serves as a base for people intending to pay a visit to the shrine.

A steep climb from the Kishori village through shades of salices, cultivated terraces, flowering meadows and extremely rugged slopes brings one to the relieving surroundings of Triloknath (2900 m). Towards the end of August the valley including Triloknath becomes quite warm. Every year during this period people from remote places gather for a fair at Triloknath in colourful dresses and caps feathered with winged seeds of *Oroxylum indicum.* They dance for hours together in simple rhythmic steps to the monotonous music of a drum and a flute.

Approach and Physiography

Before Manali — Leh High-Way was constructed people could enter the Lahul valley with great difficulty after crossing the formidable Rohtang Pass (3980 m). The fearfulness of the journey can be traced in one of the travel accounts to these areas (Borradaile 1928). At present people can cross Rohtang by bus and reach most of parts of Lahul including the Chenab valley up to Udaipur within a day from Manali, provided natural disasters do not occur.

The picturesque Lahul valley is surrounded on all sides by soaring mountains to which the easiest approach is through this pass. The whole topography within Lahul changes when the pass is crossed with a view of bleak, sunny gigantic ranges, snow clad peaks and massive glaciers. An endless descent begins from Rohtang towards the Chandra river basin to reach Koksar along the furiously windy Rohtang slope. The road crosses the Chandra at Koksar and follows the course of the river along its northern bank with a smooth course up to Sissoo. Beyond Sissoo and up to Gondla the journey continues through extremely dry bleak mountains where dwarf form of *Scabiosa speciosa* and *Nepeta eriostachya* dominate as survivors after August. A splash of green is seen wherever there is a source of stream or the slopes are artificially irrigated. Beyond Gondla the motor road descends again to the basin of the Chandra river and runs almost parallel through extremely loose and vertical slope where *Heracleum thomsoni* is a successful straggler. The river Chandra ultimately ends with a northerly course and joins the river Bhaga near Tandi.

Chenab or Chandra-Bhaga is practically the only outlet of the massive glaciated valleys of Lahul. The whole water reserve of the vast triangular glacial system of the central Himalayan ranges enclosed within the Lahul valley is drained out by two rivers of Lahul namely Chandra and Bhaga originating from the mountains situated at the northern extremities of the district at Baralacha La and encircles the glaciated region on all sides till it comes out to form a joint flow through an outlet at Tandi. The combined flow with the name Chandra-Bhaga or Chenab takes its course towards northwest through Lahul up to Thirot and then enters into Pangi subtehsil of Chamba (at present within Lahul) and ultimately flows through Kishtwar and Jammu till it emerges in Pakistan. Entrance to the upper Chenab valley through Kishtwar is not easy due to difficult terrain and un-inhabited areas of the valley in Pangi. People intending to pay a visit to Triloknath after seeing the shrine of Manimahesh in Chamba often venture to enter the upper Chenab near Shansha. But it is also a difficult route through high altitude passes and desolate areas.

From its origin near Tandi the Chenab has made its course through a narrow valley and has widened considerably at certain places like Shansha, Jahlman and Udaipur helping the development of well populated localities with flourishing cultivation. The steep mountains of Gneissic rock along the southern bank of Chenab extend as far as the border of Chamba giving a dark brown or greyish look.

The western boundary of Lahul was previously delimited by Thirot Nala and from here the southern vertical rock faces become more gradual together with the lowering of height and density of *Pinus wallichiana* in association with *Picea smithiana* increases up to Triloknath. The northern slopes of the valley on the other hand show a complete barrenness in the upper reaches and vast extension of blunt crests and troughs make the typical topography of Lahul without any tree vegetation up to Kirting. However, the picture in the basin is very different where planted Salices and cultivated fields present a beautiful colour scheme with Potato, Buckwheat, Barley and vegetable cultivation.

The mountains on the northern part of the valley are mainly composed of sedimentary deposits of clay and silt and show the forceful action of glaciation and erosion with more or less uniform dryness throughout the valley. This sunny topography is particularly dominated by *Juniperus polycarpos* (*J. macropoda*) after 16 kms from Tandi and remains uncontested by any other conifer. Apart from the massive drainage of the turbulent flow of the river several other congenial factors have changed the face of the upper Chenab both within Lahul and Pangi influencing its vegetational pattern and also by showing a remarkable demarcating zone for Lahul and Pangi along the valley.

In addition to its comparatively low altitude ranging between 2600-2900 m the valley has a good number of perennial and turbulent tributaries of Chenab between Tandi and Udaipur which are chiefly responsible for rendering the valley more hospitable and greener. The most important climatic condition which has kept the valley more moist is the absence of typical desiccating dry and chilly wind of the Chandra valley. This characteristic furious wind of easterly origin is obstructed by the high snowclad peaks at the mouth of the Chenab and is diverted towards the Bhaga valley along the upper reaches of the north facing slopes above Kardong rendering the farside of Keylang almost barren leaving only bushy *Juniperus communis*. A few stunted trees of *Pinus wallichiana* visible from Keylang are already a victim of this wind.

BOTANICAL HISTORY

The earliest information about the Botany of Lahul valley is known through the comprehensive account of plants, vegetable products and authentic records published by

Aitchison (l.c.) based mainly on Jaeschke's and his own collection gathered from within the political boundary of Lahul including the upper Chenab up to Thirot. But the account does not reveal the more interesting nature of vegetation beyond Thirot and further down along the valley in Pangi. With the establishment of better communication facilities many new plants to the existing list have been subsequently added. After Aitchison, the flora of Lahul is described in a short account by Watt (1881). He made a general collection from the upper Chenab and added information to the botanical knowledge of the valley. Later plants have been gathered from Lahul by well known collectors like Lace, Koelz, Stewart and others with their collections scattered in different herbaria of the world.

During the present century most extensive collections have been gathered by late N. L. Bor from Lahul during 1941-42 and are preserved in the Forest Research Institute Herbarium (DD.) His collections specially along Billing Nala (Billing Lungpa) are highly interesting. Koelz's collections are also very extensive from Lahul but excepting some stray gatherings very little material is available from the upper Chenab. Joshi (1952) presented a short account of the aquatic flora of Lahul and included few important plants of aquatic and moist habitat. Sethi and Negi from FRI also paid a visit in Lahul during 1958 and gathered a good collection from upper Chenab.

From Northern Circle of the Botanical Survey of India collections from Lahul and Spiti valleys have been gathered during the sixties by Rau (1960) and Nair (1964) but the area under present report remained uncovered during those visits. Recently some account of exploration and new records from the Lahul valley have been of additional information. (Kapahi & Sarin 1979 and Aswal & Mehrotra 1970). The present account is based only on the exploration conducted along the upper Chenab from Tandi to Udaipur a distance of about 50 km including the environs of Triloknath on the way.

General vegetation and botany of the route

The vegetation of this inner valley is characterised by a combination of a comparatively lush flora represented by the dry and wet Himalayan elements of both Lahul and Pangi. The explored area of the valley may be broadly divided into three sections comprising the initial dry and bleak zone from Tandi and westward about 10 km, the central well vegetated part between Kirting and Thirot and the typical flora of Pangi between Thirot to Udaipur. Towards the ultimate western part the infiltration of the characteristic wet Himalayan flora becomes apparent with the advent of exclusive stands of *Cedrus deodara* beyond Triloknath.

Tandi from where the Chenab begins is a small village situated at an altitude of 2900 m at the confluence of Chandra and Bhaga. The precipitous rocks on the farside at the beginning show a restricted growth of *Pinus wallichiana* and *Betula* sp. and largely planted Salices are the only tree vegetation around Tandi. However, on sheltered sandy slopes some characteristic plants like *Heracleum thomsoni* with stiff projecting flowering branches, yellow flowered *Galium verum* and *Heteropappus holoharmaphroditus* are common. The most interesting plant of the Chandra valley is the cream flowered *Saussurea jacea* forming green patches on the west facing slopes near Tandi. On eroded slopes and cuttings *Astragalus bicuspis, A. subumbellatus, Androsace rotundifolia, Leptorhabdos* *parviflora, Ribes alpestre, Hyoscyamus niger, Cotoneaster falconeri, Scorzonera divaricata* occur. Scattered bushes of *Rosa webbiana* are fairly common on dry open slopes. From Tandi the motor road climbs up towards Kirting along the higher reaches of the south facing slopes. *Artemisia maritima, Nepeta eriostachya* with occasional bushes of *Astragalus bicuspis* and *Rosa webbiana* are seen on the slopes. Occasional bushes of *Berberis jaeschkeana* also occur in *Salix* groves.

The southern part of the Chenab stands as a sheer wall for more than 20 kms from Tandi westward except at places where it has been interrupted by gullies, rivers or slanting morain deposits. A sparse growth of *Pinus wallichiana* and *Picea smithiana* on the steep rock is replaced by dense forest beyond Kirting of *Juniperus communis* and *Salix denticulata*. The latter flourishes specially on shady troughs and moist gullies.

Kirting marks the first village from where the valley towards its west is remarkably green with plantations and natural vegetation. A torrent flowing through the village greatly influences its vegetation and along its course there is a lush growth of *Hippophae rhamnoides* var. *turkistanica* and *Salix oxycarpa*. The slopes hold growths of *Polygonum polystachyum, Impatiens gigantea, Cirsium wallichii, Datisca cannabina, Mentha longifolia, Aster indamellus, Epilobium angustifolium, Juncus himalensis, Plantago major, Parnassia ovata, Ranunculus hirtellus, Erigeron alpinus, Medicago lupulina* and *Plantago depressa*. The herbaceous and shrubby members specially on irrigated slopes and around cultivated fields offer a typical assemblage of *Nepeta spicata, Medicago sativa, Silene vulgaris, Senecio chrysanthemoides, Heracleum lanatum, Swertia cordata, Jaeschkea gentianoides, Pedicularis pectinata, Polygonum alpinum*, and few others. Some of the characteristic herbaceous elements growing in the village along the canal banks are *Impatiens brachycentra, Elsholtzia ciliata, Chenopodium botrys* and *Cannabis indica*. Extensive areas of the valley are under Potato, Buckwheat and occasionally Barley and Wheat cultivation. Fruit trees like *Pyrus malus, Prunus armeniaca* have been planted but are mostly attacked by virus infection. Signs of similar infection are found to be spreading on introduced *Populus* also. A gentle slope extending from Shansha right to the margin of the Chenab harbours some typical plants like *Halerpestes tricuspis, Cyperus squarrosus, Calamagrostis pseudophragmites, Lotus corniculatus, Plantago major, Melilotus officinalis* and *Scirpus setaceus*. The area near the river bank is almost a sandy waste where apart from planted *Salix oxycarpa* the open areas hold *Hippophae rhamnoides, Myricaria germanica* with the twining *Polygonum dumetorum*. Comparatively drier marginal areas have *Dianthus angulatus, Polygonum paronychioides, P. tubulosum* together with occasional growths of *Heracleum thomsoni, Galium verum, Lindelofia anchusoides* and *Astragalus amherstianus*. Unlike the complete barren look of the sunny slopes between Kirting and Tandi the south facing slopes around Shansha show a profuse growth of prickly bushes of *Rosa webbiana*, and *R. macrophylla*. At some places *R. foetida* is occasionally met with on hedges. Among herbaceous perennials pioneering on the slopes are *Artemisia maritima, A. dracunculus, Origanum vulgare* and *Verbascum thapsus* and with the availability of water a lush growth of plants characteristic of Lahul makes its appearance.

The vegetation above 3000 m on the sunny aspect in the valley is very poor. This apparently barren and dry slopes have extensive growth of *Cousinia thomsoni* between 3000-3600 m. Among boulders *Meconopsis aculeata* is not uncommon but it is mostly sterile due to grazing. The semicushion forming *Minuartia lineata* is the most successful survivor. Gentle troughs have a thick covering of *Iris kumaonensis* and *Taraxacum officinale*. Some of the interesting plants along dry gullies at lower elevation are *Scutellaria prostrata, Galium serpylloides, Sempervivella acuminata, Androsace rotundifolia, Astragalus bicuspis, Cotoneaster rotundifolius.*

Comparatively richer and denser vegetation on the north facing slopes of the Chenab is seen after crossing the torrential river about 4 km west of Kirting. A bridle path from the main road leads towards the basin of the valley and after crossing the river approaches the villages Rappe and Rasse on the other side. A journey to the upper reaches alongside glacial fed streams offers congenial habitats for a number of uncommon plants not seen on the sunny slopes of the valley. Some of these are *Hyssopus officinalis* with pretty purplish blue spikes and strong aroma, *Anaphalis stoliczkai* forming graceful clumps, and *Pimpinella diversifolia, Senecio pedunculatus* f. *alba* (nov.). Their vertical distribution hardly extends more than 50 m from the level of the river water. There is a rich herbaceous growth composed of *Medicago sativa, Polygonum alpinum, Thalictrum minus, Jaeschkea gentianoides, Heracleum lanatum, Silene vulgaris, Swertia cordata, Nepeta spicata, Pedicularis pectinata, Senecio chrysanthemoides, Dactylis glomerata* and a few others near the village of Rappe. Dense thickets of thorny *Hippophae rhamnoides* var. *turkistanica* flourish on the slopes at a lower elevation.

A steep foot track from the neighbouring village Rasse climbs upwards to provide an easy route to reach the thick forest of *Pinus wallichiana* on the north facing slopes of the valley and people intending to visit Triloknath from Manimahesh go along this path. Through a vast slope of moraine deposits the winding path gradually attains height. The slope is strewn with handsome clumps of *Stipa sibirica* and some interesting species like *Heracleum thomsoni, Galium verum, Anemone rupicola,* and *Oxytropis thomsoni*. Herbaceous species like *Impatiens thomsoni, Oxyria digyna, Epilobium alpinum, Crepis multicaulis, Gnaphalium thomsoni, Taraxacum officinale* are also seen where the moraine is moist. A little higher up on a slashy rock large number of white flowering clumps of *Silene persica* and yellow flowered *Potentilla curviseta* occur.

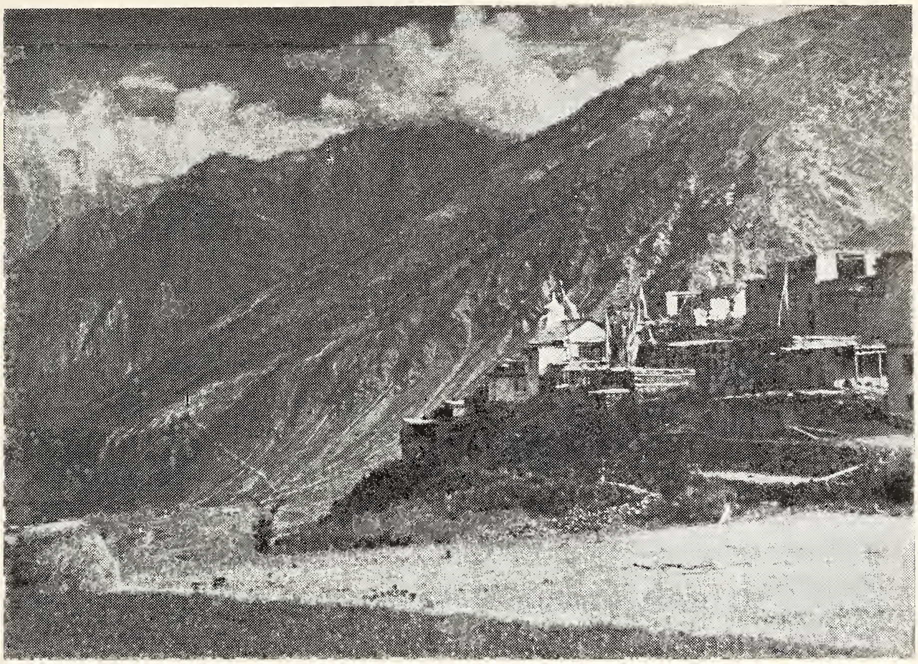
Up to this part of the Chenab valley the ultimate tree limit consists of a pure growth of *Pinus wallichiana* and is associated with *Juniperus communis, Lonicera obovata, Syringa emodi, Viburnum cotinifolium* and *Salix denticulata* as dominating undergrowth. The *Salix* gives a thick coverage specially along moist shady gullies. On dry shady slopes *Ephedra gerardiana, Bergenia stracheyi, Potentilla curviseta,* and *Polygonum affine* are the main herbs at higher reaches and on dry cliffs a few bushes of *Potentilla salessoviana* occur rarely. Above 3300 m the dry and shady rocks and slopes hold mainly *Ephedra gerardiana, Bergenia stracheyi, Potentilla curviseta* and *Polygonum affine*. A beautiful field of *Stipa sibirica* is seen on a vast west facing gentle slope. The grass is locally known as "Bohari" and is largely exploited for the panicles, which are used for making brooms.

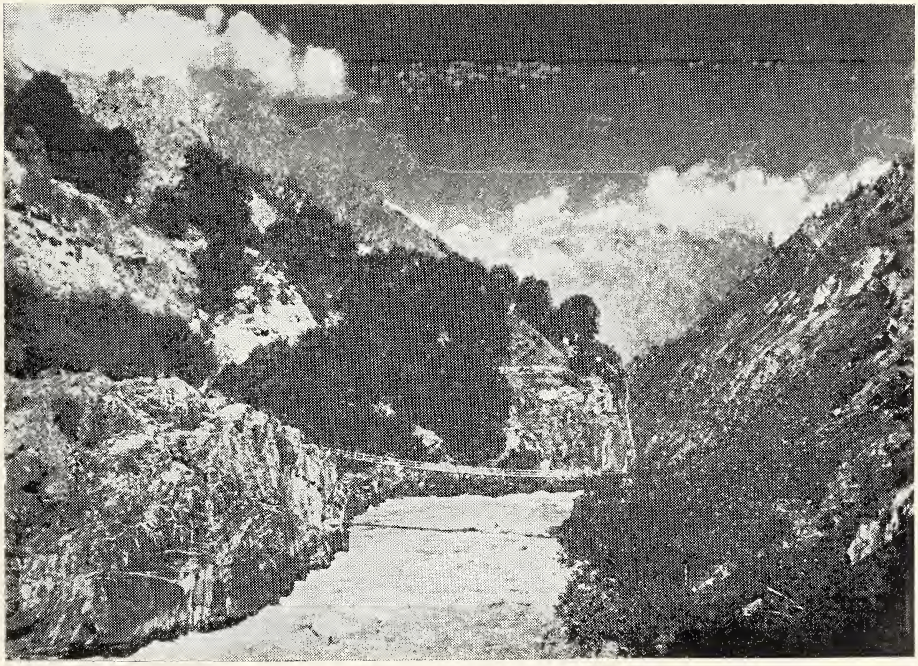
The journey from Kirting, to Jahlman does not offer any appreciable change in the composition of the vegetation on either side of the Chenab and thick plantations of *Salix oxycarpa* alongside the road provide greenery within the village. Thickets of *Rosa webbiana, Rosa* *macrophylla* associated with *Artemisia maritima* extend over large areas on dry south facing slopes on way to Jahlman. The valley at Jahlman widens and the gentle slopes provide facilities for extensive terraced cultivation by artificial irrigation.

After the bleakness of the higher reaches at Tandi, the common dry Himalayan *Juniperus polycarpos* appears again in a stunted form from Junde. Elegant forests of this Juniper flourish between Kamring and Thirot but the trees are largely infected by *Arceuthobium oxycedri* in the vicinity of Thirot. The mimicry of this obligate parasite to the foliage of the host is almost perfect and it is not detected till its action becomes detrimental to the tree. It is likely to cause tremendous loss to this species, threatening its very existence in the whole of Lahul valley in the near future. Undergrowth in this forest is rather poor and *Artemisia maritima* is found to be the best survivor. Other herbaceous elements met in this forest are *Origanum vulgare, Artemisia dracunculus, A. sacrorum, Thymus serpyllum, Chenopodium botrys, Malva pusilla, Scutellaria prostrata* and occasional bushes of *Rosa webbiana*. Near Kamring *Cymbopogon schoenanthus* is an interesting grass well represented in *Juniperus* undergrowth. In some of the forest clearings and dry gullies flourishing growths of *Sorbaria tomentosa* is a rarity for the Lahul valley. These are frequently infested with *Cuscuta reflexa*.

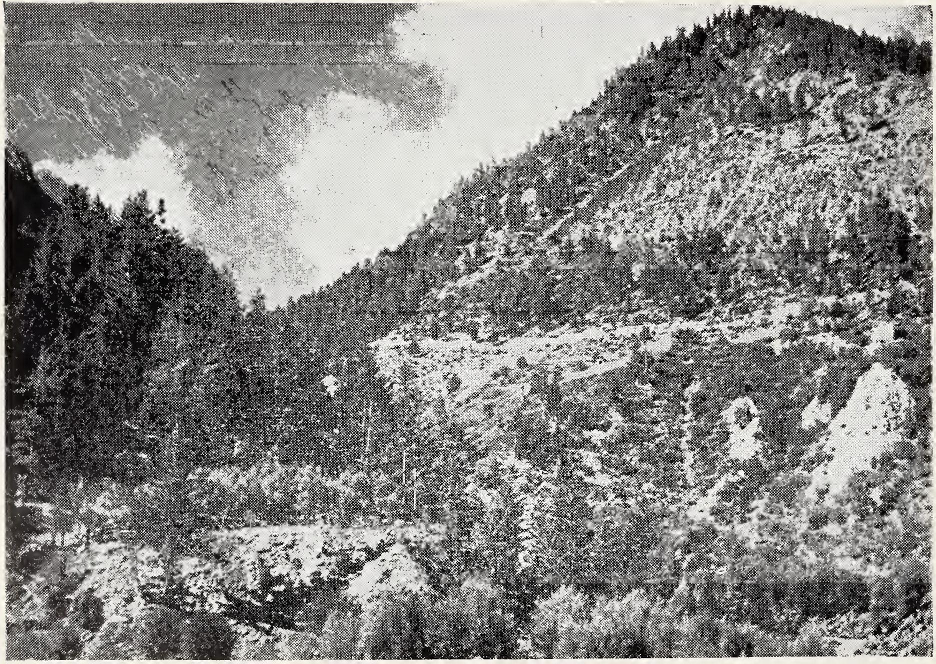
The administrative boundary of Pangi subdivision begins from Thirot. A turbulent tributary of Chenab known as Thirot Nala flows through the small village and the course preserves a similar plant community seen earlier at Kirting. Along with thickets of *Salix oxycarpa, Hippophae rhamnoides, Lonicera quinquelocularis, Viburnum cotinifolium* near the basin, the herbaceous growth is enriched by *Pedicularis punctata, Impatiens thomsonii, Datisca cannabina, Ranunculus hirtellus, Aster indamellus* and a few others.

The most interesting features of vegetation in the main valley is the isolation of the floristic elements of Pangi by a demarcating boundary towards the eastern vicinity of Thirot. The shrubby members represent a typical composition in the valley and are dominated by *Fraxinus xanthoxyloides, Berberis pseudoumbellata, Rosa webbiana, R. macrophylla, Cotoneaster pangiensis, C. roseus* and *C. gilgitensis* close to the river basin. Upward distribution of the said species on the sunny slope extend to a limited height and cover the northern bank of the river uninterruptedly between Kamring and Udaipur. The journey on way to Triloknath from Thirot offers soothing landscape with a combination of *Pinus wallichiana* and *Picea smithiana* on the north facing slope and the motor road stretching westward passes almost at a parallel height with a gentle ascent. The slopes become more rocky and drier. Few huge and wild trees of *Juglans regia* form an impressive green patch within a kilometer from Thirot. Some of the typical members of Rosaceae like *Crataegus oxyacantha, Pyrus jacquemontii* are commonly associated with the scrubby elements noted earlier. Excepting in rarely moist situation the herbaceous members are poorly represented within the dry shrubby vegetation however, the common ones are *Artemisia maritima, A. sacrorum, Origanum vulgare, Rumex nepalensis, Pterotheca falconeri, Verbascum thapsus, Thymus serpyllum, Chenopodium botrys, Scrophularia koelzii, Datisca cannabina, Herniaria hirsuta* and few others. On dry cliffs *Seseli sibiricum* is a rarely collected strongly aromatic plant frequently come across but mostly they are inaccessible.





Above: Triloknath temple and sunny slope strewn with stunted *J. polycarpos* Koch.
Below: *Salix oxycarpa* Anders. at Kishori village below Triloknath.



Above: Natural forests of *Cedrus deodara* (Roxb.) G. Don at Pangi near Udaipur.

Below: Contrasting *Juniperus* and *Cedrus* on northern and southern slope respectively.

Spiraea canescens and *Solidago virga-aurea* are also common on rocky slopes.

From the main bus route a mule track branches downwards about two kilometres before Triloknath and approaches a suspension bridge over the Chenab. In addition to common shrubby vegetation *Plectranthus rugosus* and *Sorbaria tomentosa* infested with *Cuscuta reflexa* mark changing components on this route. On a moist slope elegant growth of *Impatiens roylei* and *Inula grandiflora* are interesting to come across. An impressive view of the unrivalled scenery appears from the suspension bridge while approaching the village at the foot of Triloknath. A steep climb through planted *Salix oxycarpa* begins from the bridge to the neighbouring Kishori village. Due to adequate irrigation facilities the small village maintains a considerable area under cultivation of common Potato and Buckwheat and in addition small plots containing wheat, barley and few vegetables are not uncommon. The vegetation around the village does not show any interesting feature except in pools along the shady river bank, where characteristic plants of aquatic habitats such as *Polygonum hydropiper* ssp. *megalocarpum*, *Eleocharis palustris*, *Limosella aquatica*, *Callitriche verna*, *Triglochin palustre* and *Halerpestes sarmentosa* occur. The moist slopes and waste lands around cultivated fields hold *Carum carvi*, *Corydalis ramosa*, *Dactylis glomerata*, *Geranium aconitifolium*, *Lamium amplexicaule*, *Lepyrodiclis holosteoides*, *Medicago sativa*, *Nepeta spicata*, *Senecio chrysanthemoides*, *Swertia cordata*, *Trifolium repens*, *Urtica dioica*, *Veronica persica* etc. A lush and interesting vegetation is seen on the north bank of the Chenab near the village. Due to low height (2400 m) of the valley here, several wet and semidry habitat Himalayan plants like *Salvia nubicola*, *Sium latijugum*, *Campanula latifolia*, *Codonopsis rotundifolia*, *Lespedeza juncea*, *Medicago lupulina*, *Nepeta linearis*, *Elscholtzia ciliata*, *Bothriochloa ischaemum*, *Phragmites australis*, *Allium rubellum*, *A. strachyi*, *Jurinea ceratocarpa*, *Leibnitzia nepalensis* etc. present a characteristic vegetation on the shady river bank.

A journey to Triloknath proper from Kishori village begins through an irrigated pasture and then a rugged dry rocky slope with a steep ascent till the plateau is reached. Excepting a thin scrubby growth of *Rosa webbiana*, *Prunus jacquemontii*, *Fraxinus xanthoxyloides* accompanied by few interesting plants like *Heteropappus altaicus*, *Dianthus angulatus*, *Physochlaina paraealta*, *Rubia cordifolia* etc. the route beyond the village does not sustain notable plants. On the other hand the vegetation becomes more interesting while climbing the slopes above Triloknath to reach the thick forest of *Pinus wallichiana* and *Picea smithiana*. The moist irrigated north facing slopes have *Angelica glauca*, *Anaphalis cuneifolia*, *Astragalus himalayanus*, *Bupleurum jucundum*, *B. falcatum*, *Galium boreale*, *Pedicularis pectinata*, *Polygonum alpinum*, *P. polystachyum*, *P. nepalense*, *P. hydropiper*, *Corydalis ramosa*, *Valeriana hardwickii*, *Orchis latifolia*, *Herminium monorchis*, *Polygonatum geminiflorum*, *Phlomis bracteosa* and others.

An exploratory trip along the adjoining valley of Hinsa Nala up to the limit of the glacial moraine through the *Pinus-Picea* forest was fascinating. The extension of the narrow valley of the stream does not show a rich herbaceous growth. A few shrubs of *Syringa emodi*, *Viburnum cotinifolium*, *Ribes alpestre*, *Rubus irritans*, *Berberis pachyacantha*, *Sorbus aucuparia* are come across. Before the termination of the stream at the moraine deposits the thickness of the *Pinus-Picea* forest declines and ultimately the slopes support prostrate bushes of *Juniperus communis* only. The sheltered slopes supported *Polygonum affine* and *Bergenia stracheyi* on rocks. At higher reaches *Ephedra gerardiana* is also found to flourish on shady rock. The slopes towards the bottom of the valley appears to be quite bleak and *Nepeta discolor, Taraxacum officinale, Leontopodium alpinum, Galium serpylloides* together with few ferns like *Asplenium trichomanes, A. septentrionale* and *Pellaea gracilis* are met with.

The Chenab valley widens considerably towards west of Triloknath near Udaipur and a remarkable change in the tree vegetation is noted by the appearance of *Cedrus deodara* on both sides of the valley. A high rate of natural regeneration becomes evident by their extensive distribution on the slopes as well as on the river bed and adjoining plains. In the undergrowth and on barren slopes the dominant plants are *Artemisia maritima* and *Juniperus communis*. The latter, however, is more on open slopes facing north. The dry open slopes when devoid of any tree growth is covered mainly by *Artemisia maritima*. There is a marked stuntedness of *Juniperus polycarpos* on way to Udaipur from Triloknath and similarly the general shrubby vegetation on the sunny part, represented by *Fraxinus, Cotoneaster, Berberis, Ribes* and *Rosa* are also much dwarfed in habit. On river banks and slopes a few uncommon plants are come across namely *Echinops cornigerus, Scrophularia scabiosaefolia, Hypericum perforatum, Erianthus ravennae*. Excepting the handsome Cedars the area around Udaipur has poor vegetation and a few planted trees give a monotonous landscape to the village represented by *Populus alba, Salix oxycarpa, Juglans regia, Prunus armeniaca* etc.

A list of plants gathered during the trip are ennumerated with short field notes and all the collection numbers are deposited at BSD under the senior author's name. As the period of collection is restricted to 12th to 23rd August, 1971, the date of collection has not been specifically mentioned. As far as practicable the nomenclature of plants have been brought up to date. Plants not recorded earlier are marked with an asterisk.

DICOTYLEDONS

RANUNCULACEAE

Anemone rupicola Camb.
On north facing dry slope, flowers white.
Rasse 3000 m, 45343.

Halerpestes sarmentosa (Adams) Komarov
On moist soil and shady pools, flowers yellow.
Shansha 2800 m, 45253; Kishori 2400 m, 45992.

Ranunculus hirtellus Royle
On moist shady slope, flowers yellow.
Kirting 2900 m, 45289.

R. hyperboreus Rottb.
On slushy slope, flowers yellow.
Rasse 3200 m, 45327.

Thalictrum minus Linn. var. **foetida** (Linn.) Hook. f. & Thoms.
On west facing moist slope. In fruit.
Roding 3000 m, 45309.

BERBERIDACEAE

Berberis jaeschkeana Schneid.
Under shade of salices. Fruits green.
Lot 3200 m, 40704.

B. pachyacantha Koehne
On shady slope within Picea- Pinus forest. Fruits reddish green.
Triloknath, Hinsa Nala 3200 m, 45911.

B. pseudumbellata Parker
On south facing dry slope. Fruits pruinose blue.
Thirot 2600 m, 45359.

FUMARIACEAE

Corydalis ramosa Wall. ex Hook. f. & Thoms.
Along north facing gully, flowers yellow.
Triloknath 2900 m, 45904.

BRASSICACEAE (CRUCIFERAE)

Brassica napus Linn.
Occasionally cultivated.
Rappe 2600 m, 45334.

Descurainia sophia (Linn.) Webb. ex Prantl.
On roof of houses, flowers yellow.
Kishori 2400 m, 45382.

Thlaspi arvense Linn.
Weed in Potato field, flowers white, fruits orbicular.
Triloknath 2900 m, 45396.

CARYOPHYLLACEAE

Arenaria serpyllifolia Linn.
On dry south facing slope, Fruiting cymes.
Rappe 2600 m, 45331.

Cerastium glomeratum Thuill.
On moist shady slope, flowers white.
Thirot 2600 m, 45379.

Dianthus angulatus Royle
On dry river bed and stony slope, flowers pink and white.
Shansha 2800 m, 45265; Triloknath 2800 m, 45924.

* **Herniaria hirsuta** Linn.
On shady soil, flowers and fruits minute.
Thirot 2600 m, 45369; Udaipur 2400 m, 45942.

* **Lepyrodiclis holosteoides** Fenzl. ex Fisch. et Mey.
A weed in cultivated field, flowers white.
Shansha 2800 m, 45241; Triloknath 2700 m, 45927.

Sagina saginoides (Linn.) Karsten
On moist shady soil, flowers green.
Thirot 2600 m, 45371.

Silene persica Boiss. ssp. **moorcroftiana** (Rohrb.) Chaudhuri
On moist rock and shady slopes, flowers white, purple beneath.
Rasse 3200 m, 45320; Triloknath 3000 m, 45998.

S. vulgaris (Moench.) Garcke
On moist irrigated slopes, flowers white.
Shansha 2800 m, 45280.

Stellaria media (Linn.) Vill.
On shady slopes, flowers white.
Kirting 2900 m, 45293.

TAMARICACEAE

Myricaria germanica (Linn.) Desv.
On sandy river-bed. Fruiting spikes present.
Shansha 2800 m, 45236.

GUTTIFERAE (HYPERICACEAE)

* **Hypericum perforatum** Linn.
On dry rocky slopes, flowers yellow.
Thirot 2600 m, 45350; Triloknath 2800 m, 45951.

MALVACEAE

Malva pusilla Sm.
On waste land around villages.
Kirting 2900 m, 45241; Kishori 2400 m, 45999.

GERANIACEAE

* **Geranium aconitifolium** L'Herit
On moist north facing slopes, flowers showy purple.
Kishori 2400 m, 45974.

G. nepalense Sw.
On shady slopes, flowers pale pink.
Kirting 2900 m, 45244.

* **Erodium stephanianum** Willd.
On north facing stony slopes, flowers pink.
Triloknath 2600 m, 45994.

BALSAMINACEAE

* **Impatiens brachycentra** Kar. et Kir.
On shady, moist, slopes, flowers small pinkish white.
Thirot 2600 m, 45383.

CELASTRACEAE

* **Euonymus fimbriatus** Wall. ex Roxb.
On open rocky areas. In fruit. Rare.
Thirot 2600 m, 45884.

RHAMNACEAE

* **Rhamnus prostrata** Jacq. ex Parker
On dry cliffs. In fruit.
Kirting 3500 m, 45316.

PAPILIONACEAE

Astragalus amherstianus Benth.
On dry sandy river beds. In fruit.
Shansha 2800 m, 45263.

A. himalayanus Klotzsch
On moist irrigated slope, flowers purple.
Kishori 2400 m, 45903.

Lens culinaris Medic.
In waste land cultivated field. In fruit.
Kirting 2800 m, 45250.

* **Lespedeza juncea** (Linn. f.) Pers.
On dry gentle slopes, flowers white.
Udaipur 2400 m, 45941.

Lotus corniculatus Linn.
On moist irrigated plains, flowers yellow and orange.
Shansha 2800 m, 45238.

Medicago lupulina Linn.
In shady wastelands, flowers yellow, fruits black.
Kishori 2400 m, 41298.

M. sativa Linn.
On moist irrigated slopes, flowers yellow.
Kishori 2400 m, 45997.

* **Melilotus alba** Medic.
On open irrigated slopes, flowers white.
Roding 3000 m, 45311.

* **M. officinalis** (Linn.) Pallas
In open irrigated plains, flowers yellow.
Shansha 2800 m, 45240; Kishori 2400 m.

Oxytropis thomsoni Benth. ex Baker
On dry slopes, flowers purple.
Roding 3000 m, 45314; Rasse 3000 m, 45322

ROSACEAE

* **Crataegus oxyacantha** Linn.
On dry open stony slopes, fruits red.
Thirot 2600 m, 45364; Kishori 2400 m, 45948.

Fragaria vesca Linn.
On shady slopes, flowers white.
Kishori 2400 m, 45982.

Potentilla argyrophylla Wall. var. **leucochroa** Hook. f.
On glacial scree, flowers yellow.
Rasse 2900 m, 45347.

P. ambigua Camb.
On glacial scree, flowers yellow.
Rasse 2800 m, 45342.

Potentilla curviseta Hook. f.
On shady cliffs, flowers yellow.
Rasse 3600 m, 45340.

Potentilla salessoviana Steph.
On shady dry rocks. In fruit.
Rasse 3400 m, 45338.

* **Prunus jacquemontii** Hook. f.
On rocky slopes. Fruits red.
Triloknath 2800 m, 45934.

Pyrus baccata Linn.
On south facing dry slopes, fruits reddish green.
Thirot 2600 m, 45362.

Rosa foetida Herrm.
Along hedges, flowers yellow.
Shansha 2500 m, 45313.

R. macrophylla Lindl.
On open stony slopes, flowers pale pink.
Kirting 2800 m, 45293.

R. webbiana Wall. ex. Royle
On dry stony slopes, flowers pink.
Shansha 2800 m, 45333.

Rubus irritans Focke
On shady slopes with *Picea* forming large patches, fruits orange.
Hinsa Nala 3000 m, 45910.

* **Sorbaria tomentosa** (Lindl.) Rehder
Along narrow gullies facing south, fruits in brown panicle.
Thirot 2600 m, 45360.

Sorbus aucuparia Linn.
On shady slope in *Picea* forest, fruits white.
Triloknath 2900 m, 45908.

Spiraea canescens D. Don
On open stony slopes, flowers white.
Thirot 2600 m, 45348; 45354.

PARNASSIACEAE

Parnassia ovata Ledeb.
On moist shady slopes, flowers white.
Kirting 3000 m, 45290.

SAXIFRAGACEAE

Saxifraga sibirica Linn.
Under shade of boulders, flowers white.
Kishori 2400 m, 45983.

GROSSULARIACEAE

Ribes alpestre Wall. ex Dcne.
On shady slopes in Picea forest, fruits orange coloured.
Hinsa Nala 3200 m, 45908.

R. orientale Desf.
On slopes alongside turbulent stream, fruits yellow.
Thirot 2600 m, 45372.

CALLITRICHACEAE (HALORAGIDACEAE)

* **Callitriche verna** Linn.
In shallow pools, flowers minute green.
Kishori 2400 m, 45959.

CRASSULACEAE

Sedum acuminatum R. Hamet
Along dry stony gullies, flowers white.
Roding 3000 m, 45297.

ONAGRACEAE

* **Epilobium brevifolium** D. Don
On slushy stony areas, flowers pink.
Kirting 2900 m, 45284.

E. royleanum Haussk.
On moist stream beds, flowers pink.
Kirting 2900 m, 45287.

CUCURBITACEAE

* **Bryonia dioica** Jacq.
On hedges in waste lands, flowers & fruits green.
Triloknath 2800 m, 45931.

DATISCACEAE

* **Datisca cannabina** Linn.
On sandy slope along gullies and always on sunny part of the valley. Flowers dioecious pale green.

APIACEAE (UMBELLIFERAE)

* **Angelica glauca** Edgew.
On north facing irrigated slope, fruits large winged.
Triloknath 2900 m, 45905.

Bupleurum falcatum Linn. var. **marginatum** (Wall. ex DC.) C. B. Clarke.
On moist north facing slope, flowers yellow.
Triloknath 2900 m, 45916.

B. jucundum Kurz
On moist irrigated slope, flowers yellow.
Triloknath 2900 m, 45913.

Carum carvi Linn.
On moist shady slope, flowers white.
Triloknath 2700 m, 45975.

Ferula jaeschkeana Vatke
On dry slopes, fruits large purple.
Roding 3000 m, 45310.

* **Heracleum thomsoni** C. B. Clarke
On sandy riverbed, flowers white.
Shansha 2800 m, 45267.

* **Pimpinella diversifolia** DC.
On moist slopes along river bank, flowers white.
Rappe 2800 m, 45325.

* **Seseli sibiricum** (Linn.) Boiss.
On steep dry rock, flowers white. Pungently aromatic, not collected earlier, during this century.
Thirot 2600 m, 45387.

* **Sium latijugum** C. B. Clarke
Along irrigation canal in shade, flowers white.
Hinsa 2400 m, 45939.

CAPRIFOLIACEAE

Lonicera heterophylla Dcne.
On banks of a turbulent streams, fruits red.
Thirot 2650 m, 45378.

L. obovata Royle ex Hook. f.
On shady north and west facing slopes, fruits blue.
Rasse 3400 m, 45335.

L. quinquelocularis Hardw.
On banks of turbulent streams, fruits green.
Kirting 2900 m, 45275.

Viburnum cotinifolium D. Don
On shady stream bank, fruits purple.
Thirot 2650 m, 45374.

RUBIACEAE

Galium boreale Linn.
On moist irrigated slopes, flowers white.
Triloknath 2900 m, 45925.

G. serpylloides Royle ex Hook. f.
On open stony slopes, fruits white, bristly.
Roding 3000 m, 45295; Hinsa Nala 3100 m, 45392.

G. verum Linn.
On dry sandy river bed, flowers yellow.
Shansha 2800 m, 45266.

Rubia cordifolia Linn.
On shady slopes, fruits black.
Kirting 2900 m, 45281; Triloknath 2700 m, 45923.

VALERIANACEAE

Valeriana hardwickii Wall.
On shady slopes, flowers white.
Kishori 2400 m, 45914.

ASTERACEAE (COMPOSITAE)

Aichillea millefolium Linn.
On moist irrigated slopes, heads with yellow disk and white rays.
Shansha 2800 m, 45300.

Anaphalis cuneifolia Hook f.
On shady slopes, heads scarious white.
Triloknath 2900 m, 45922;

A. royleana DC.
In Pine forest undergrowth, heads scarious white.
Triloknath 2600 m, 45971.

A. stoliczkai C. B. Clarke
On river bank slopes along Chenab, heads white.
Rappe 2800 m, U.C.B. 45829.

Anthemis cotula Linn.
In shady waste lands around village, heads with white rays and yellow disc.
Shansha 2800 m, 45243.

Arctium lappa Linn.
In shady waste land, heads purple thin hooked spines.
Kishori 2600 m, 45967.

Artemisia maritima Linn.
On dry slopes, head cinereous.
Kirting 2900 m, 45251; Udaipur 2400 m. 45969.

A. nilagirica Pampanini.
On moist slope, heads brown.
Thirot 2650 m, 45361.

A. sacrorum Ledeb.
On dry shady rock, heads yellow.
Kishori 2600 m, 45970.

A. scoparia Waldst. et Kit.
On sandy river bed and fallow fields, heads greenish white.
Shansha 2800 m, 45229; Kishori 2600 m, 45980.

* **A. tournefortiana** Reichb.
On slopes alongside road, heads green in strict panicles.
Kamri 2900 m, 45302.

Aster indamellus Grierson
On shady slope along irrigation canal, heads white.
Kirting 2900 m, 45272.

Brachyactis umbrosa Benth.
In shady waste lands, heads yellow.
Shansha 2800 m, 45286.

Carduus nutans Linn.
On dry exposed soil slope, heads purple.
Kirting 2900 m, 45268.

* **Cirsium wallichii** DC. var. **platylepis** Hook. f.
On open slope, heads white.
Kirting 3600 m, 45319.

Cousinia thomsoni C. B. Clarke
On south facing dry slope, heads purple. Abundant above 3400 m.
Roding 3000 m, 45306.

Crepis multicaulis Ledeb. ssp. **genuina** (Regel) Babe.
On moist glacial morain, heads yellow.
Rasse 3400 m, U.C.B. 45341.

Echinops cornigerus DC.
On terraced open slope, heads spherical white.
Opposite Kishori 2400 m, 45949.

Erigeron alpinus Linn.
On shady slope, heads lilac.
Kirting 2900 m, 45279; Triloknath 2800 m, 45995.

* **E. canadensis** Linn.
In waste land alongside road, heads yellowish white.
Udaipur 2400 m, 45943.

* **Filago arvensis** Linn.
On moist open slope, heads white.
Triloknath 2700 m, 45928.

* **F. spathulata** Presl.
On shady slope, heads brownish white.
Shansha 2800 m, 45288.

* **Galinsoga parviflora** Cav.
Along shady gullies, disc yellow, rays white.
Thirot 2600 m, 45358.

* **Gnaphalium thomsoni** Hook f.
On moist morain slope, heads white.
Rasse 3500 m, 45324.

Heteropappus altaicus (Willd.) Novopokr. var. **altaicus**
On north facing stony slope, rays white disc yellow.

Thirot 2650 m, 45367; Triloknath 2700 m, 45393.

Inula grandiflora Willd.
On slushy south facing slope, heads yellow.
Triloknath 2400 m, 45383.

I. racemosa Hook. f.
Stout, planted, medicinal herb, heads large yellow.
Kamring 26500 m, 45370.

Jurinea cerotocarpa (Dcne.) Benth.
On boulders containing soil, heads purplish white.
Kishori 2400 m, 45947.

Lactuca sativa Linn.
Cultivated, heads yellow.
Kishori 2650 m, 45938.

* **Leibnitzia nepalensis** (Kunze) Kitamura.
On shady moist slope in *Picea* forest, with young heads.
Kishori east 2600 m, 45977.

Saussurea albescens (DC.) Hook. f. & Thoms.
On open irrigated slope, heads white.
Roding 3000 m, 45301.

S. jacea (Klotzsch) C. B. Clarke
On loose eroded slope, heads cream white.
Tandi 2900 m, 45132.

Senecio chrysanthemoides DC.
On open irrigated slope, heads yellow.
Shansha 2800 m, 45282; Kishori 2600 m, 45968.

Senecio pedunculatus Edgew.
On shady soil slope, heads yellow.
Kishori 2500 m, 45984.

S. pedunculatus Edgew. var. **albus** nov.
On moist slope in shade on river bank, heads white.
Rappe 2600 m, 45329.

Solidago virga-aurea Linn.
On steep rock fissure, heads yellow.
Thirot 2600 m, 45349.

Taraxacum officinale Wigg.
On dry, stony, west facing, slope, heads yellow.

CAMPANULACEAE

Campanula latifolia Linn.
On shady slope. In fruit.
Kishori 2600 m, 45938.

Codonopsis rotundifolia Benth.
On shady slope. In fruit.
Kishori 2600 m, 45945.

PRIMULACEAE

Androsace rotundifolia Hardw.
On stony slope along gullies. In fruit.
Roding 3000 m, 45304.

OLEACEAE

Fraxinus xanthoxyloides Wall. ex DC.
Most common shrub on dry south facing slope, near river basin, fruits winged in attractive fascicles.
Thirot 2000 m, 45353; Triloknath 2500 m, 45952.

* **Jasminum humile** Linn.
On south facing submoist slope. In fruit, flowers yellow.
Thirot 2600 m, 45365.

Syringa emodi Wall. ex D. Don
On shady slope. In fruit.
Hinsa Nala 300 m, 45907.

GENTIANACEAE

Jaeschkea gentianoides Kurz
On moist irrigated slope, corolla purplish white, inflated.
Rappe 2800 m, 45323.

Swertia cordata (G. Don) C. B. Clarke
On moist irrigated slope, flowers white.
Shansha 2800 m, 45247; Kishori 2600 m, 45926.

BORAGINACEAE

Eritrichium fruticulosum Klotzsch
On shady stony slope, flowers blue.
Kishori 2600 m, 45964.

Pseudomertensia echioides (Benth.) Riedl.
On open rocky slope, flowers purplish blue.
Triloknath 3000 m, 45391.

SOLANACEAE

Hyoscyamus niger Linn.
In shady waste land flower dull yellow with purple network.
Shansha 2800 m, 45234.

* **Nicotiana rustica** Linn.
In shady waste land, flowers palegreen.
Shansha 2800 m, 45339.

Physochlaina praealta Miers
On rocky slope, flowers pale green.
Triloknath 2700 m, 45394.

Solanum nigrum Linn.
On rocky slope facing north, flowers white, fruits orange.
Triloknath 2800 m, 45932.

S. tuberosum Linn.
Cultivated, excessively flowering & fruiting.
Shansha 2800 m, 45345.

SCROPHULARIACEAE

* **Euphrasia flabellata** Pennell
On moist irrigated slope, flowers white.
Kirting 3000 m, 45307.

Euphrasia jaeschkei Wettst.
On west facing semidry slope, flowers violet.
Rasse 3400 m, 45332.

Limosella aquatica Linn.
In fresh water pool, flowers minute, pale blue.
Kishori 2600 m, 45991.

Pedicularis pectinata Wall. ex Benth.
On irrigated shady slope. In fruit.
Triloknath 2900 m, 45915.

P. punctata Dcne.
On moist open slope, flowers purple.
Thirot 2650 m, 45380.

Scrophularia koelzii Pennell
On dry south-facing slope, flowers pinkish white.
Opposite Kishori 2700 m, 45946.

Veronica beccabunga Linn.
Along shaded stream, flower pale blue.
Kirting 3000 m, 45315.

V. persica Poir.
On borders of cultivated field, flowers blue.
Kishori 2600 m, 45987.

LAMIACEAE (LABIATAE)

Clinopodium umbrosum (M.B.) C. Koch.
On moist irrigated slope, flowers pink.
Shansha 2800 m, 45283.

Elsholtzia ciliata (Thunb.) Hyland.
On shady slope, flowers white.
Kirting 2900 m, 45291, Kishori 2600 m, 45940.

E. densa Benth.
In cultivated field, flowers pink.
Shansha 2800 m, 45262; Triloknath 2800 m, 45920.

* **Hyssopus officinalis** Linn.
On slopes along river, flowers purplish blue.
Rappe 2600 m, 45330; Kishori 2500 m, 45955.

* **Mentha longifolia** (Linn.) Huds. var. **royleana** (Benth.) Raiz. et Saxena
Along water course, flowers pale pink.
Kirting 3000 m, 45277; Kishori 2600 m, 45953.

Nepeta discolor Royle ex Benth.
On west facing dry slopes, flowers blue.
Hinsa Nala 3200 m, 45400.

N. linearis Royle
On south facing stony slope, flowers pale pink.
Kishori 2600 m, 45950.

N. spicata Benth.
On borders of cultivated field, flowers blue.
Kishori 2600 m, 45972.

Origanum vulgare Linn.
On dry slopes, flowers white.
Shansha 2900 m, 45252.

Plectranthus rugosus Wall.
On open slopes along river, flowers white.
Kishori 2500 m, 45957.

Salvia nubicola Sweet
On shady moist slope, flowers yellow.
Kishori 2600 m, 45944.

Scutellaria prostrata Jacq. ex Benth.
On dry slopes, flowers yellowish white.
Kirting 2900 m, 45285; Thirot 2600 m; 45389

* **Stachys sericea** Wall.
On moist irrigated slope, flowers pale pink.
Shansha 2800 m, 45245.

Thymus serpyllum Linn.
On cutting slopes, flowers white.
Kishori 2600 m, 45998.

* **Ajuga bracteosa** Wall. ex Benth.
In Pinus forest undergrowth, flowers white|
Kishori east 2600 m, 45996.

PLANTAGINACEAE

* **Plantago asiatica** Linn.
On moist irrigated field, spikes green.
Shansha 2800 m, 45232.

Plantago depressa Willd.
On shady soil slope, spikes green.
Kirting 3000 m, 45296; Kishori 2600 m, 45973.

AMARANTHACEAE

Amaranthus hybridus Linn. ssp. **cruentus** (Linn.) Thell.
Cultivated, panicle red or yellow.
Kishori east 2600 m, 46000.

CHENOPODIACEAE

Chenopodium album Linn.
In cultivated field, spikes green capitate.
Triloknath 2800 m, 45976.

C. botrys Linn.
Common, not collected.
Shansha 2800 m.

C. foliosum (Moench.) Aschrs.
In dry waste places, fruits red juicy.
Thirot 2600 m, 45378.

* **C. hybridum** Linn.
In shady waste places, spikes green.
Shansha 2800 m, 45259.

POLYGONACEAE

* **Fagopyrum esculentum** Moench.
In shady waste places, flowers white.
Shansha 2800 m, 45239.

Oxyria digyna Hill.
On morain slope, flowers yellow, fruits red.
Hinsa Nala 3200 m, 45909.

Polygonum affine D. Don
On stony slope, spikes pink.
Triloknath, Hinsa Nala 3300 m, 45399.

P. alpinum All.
On north facing irrigated slope, flowers white.
Triloknath, 2900 m, 45912.

P. aviculare Linn.
Under shade of *Salix*, flowers white.
Shansha 2800 m, 45230.

* **P. dumetorum** Linn.
Twining on *Hippophae*, flowers green, fruits winged.
Shansha 2800 m, 45259.

* **P. glabrum** Willd.
On moist cultivated field, flowers pink.
Triloknath 2900 m, 45921.

P. glaciale Hook. f.
On submoist stony slope, flowers pale green.
Hinsa Nala 3200 m, 45390.

* **P. hydropiper** Linn. ssp. **megalocarpum** Danser
In shallow water pools, flowers white.
Kishori 2600 m, 45963.

P. paronychioides C. A. Mey.
On dry sandy river bed, flowers pink.
Shansha 2800 m, 45261.

P. polystachyum Wall. ex Meissn.
On moist slope alongside stream, flowers white.
Kirting 2900 m, 45292.

* **P. tubulosum** Boiss.
On dry river bed and stony slopes, flowers pink.
Shansha 2800 m, 45260; Triloknath 3100 m, 45395.

P. viviparum Linn.
On moist irrigated slope, flowers white.
Triloknath 2900 m, 45929.

Rumex nepalensis Spreng.
Along irrigation canal, flowers green, fruits with hooked bristly wings.
Triloknath 2900 m, 45918.

ELAEAGNACEAE

Happophae rhamnoides Linn. subsp. **turkistanica** A. Rausi
Extremely common along gullies and moist slope, fruits yellow.
Kirting-Shansha 2800 m, 45257; 45270.

LORANTHACEAE

Arceuthobium oxycedri M. Bieb.
A common parasite on *Juniperus polycarpos* forming moss like fascicles. A heavily infected tree dies after a few years. There are indications of much damage to several standing trees. Infections are localised and not widespread in the valley.
Thirot 2600 m, 45351.

URTICACEAE

Parietaria debilis Forst.
Under shade of boulders, flowers minute pale green.
Kirting 2900 m, 45256.

Urtica dioica Linn.
On shady slope and along hedge, flowers pale green.
Kishori 2650 m, 45985.

CANNABIDACEAE

Cannabis sativa Linn.
In waste land around village, flowers white green.
Shansha 2800 m, 45248, 45249.

JUGLANDACEAE

Juglans regia Linn.
Gregarious on south facing submoist slope with fruits.
Thirot 2650 m, 45368.

SALICACEAE

Salix denticulata Anderss.
Along moist north facing gullies. In fruit, catkins.
Rasse 3400 m, 45337.

S. oxycarpa Anderss.
Along turbulent stream course. In fruit, catkins. Largely planted alongside road in villages.
Kirting 2900 m, 45271.

MONOCOTYLEDONS

ORCHIDACEAE

Herminium monorchis (Linn.) R. Br.
On moist irrigated slope, flowers green.
Triloknath 2900 m, 45930.

Orchis latifolia Linn.
On north facing moist irrigated slope. In fruit.
Triloknath 2900 m, 45917.

IRIDACEAE

Iris kumaonensis Wall. ex D. Don
Along shady moist gullies under planted salices, with fruits.
Kirting 3000 m, 45308.

LILIACEAE

Allium rubellum M. Bieb.
On stone slab along river bank, flowers purple.
Kishori 2600 m, 45936.

A. sativum Linn.
Occasionally cultivated, flowers white.
Roding 3000 m, 45294.

A. stracheyi Baker
On shady stone slab along river bank, flowers white.
Kishori 2600 m, 45935.

JUNCACEAE

Juncus bufonius Linn.
On moist shady slope, flowers green.
Kishori 2650 m, 45956.

J. himalensis Klotzsch
Along canals on shady slope, spikes brown.
Kirting 2900 m, 45275; Thirot 2600 m, 45373.

J. lampocarpus Ehrh.
Along canals on shady slope, flowers green.
Thirot 2650 m, 45375.

JUNCAGINACEAE

Triglochin palustre Linn.
On moist shady north-facing slope, with green fruits.
Triloknath, 2900 m, 45919.

CYPERACEAE

* **Cyperus squarrosus** Linn.
On moist irrigated plain, spikes green.
Shansha 2800 m, 45254.

Eleocharis palustris R. Br.
In shallow water, spikes white.
Kishori 2600 m, 45990.

Scirpus setaceus Linn.
On moist open field with brownish green spikes.
Shansha 2800 m, 45255; Kishori, 2600 m, 45954.

POACEAE (GRAMINEAE)

Agropyron canaliculatum Navski
On sandy river bank, spikes purplish green.
Shansha 2800 m, 45237.

Agrostis canina Linn.
On semidry open plain, spikes pale-brown.
Shansha 2800 m, 45233.

A. stolonifera Linn.
On moist sandy stream bed with purplish brown panicle.
Kirting 2900 m, 45276.

* **Arthraxon prionodes** (Steud.) Dandy
On dry stony slope, panicle purple.
Triloknath 2600 m, 45386.

Bothriochloa ischaemum (Linn.) Keng
Gregarious on north-facing slope, panicle purple.
Kishori 2600 m, 45979.

Bromus japonicus Thunb.
On sandy river bank, spikes purplish green.
Shansha 2800 m, 45231.

Calamagrostis pseudophragmites (Hall. f.) Koeler
On moist sandy stream bed, panicle purplish green.
Kirting 2900 m, 45235; Thirot 2650 m, 45355.

* **Chrysopogon echinulatus** (Nees) W. Wats
On open south facing slope, panicle dark purple.
Roding 3000 m, 45299.

* **Cymbopogon schoenanthus** (Linn.) Spreng.
On dry slopes under *Juniperus.*
Kamri 2700 m, 45377.

Dactylis glomerata Linn.
On moist slope around cultivated field, spikes white.
Kishori 2600 m, 45989.

* **Eragrostis poaeoides** P. Beauv.
On fallow fields, panicle blackish green.
Kishori 2600 m, 45981.

* **Erianthus ravennae** (Linn.) P. Beauv.
On south facing sandy eroded slope, panicle purple, large,
Kishori 2600 m, 45958.

* **Oryzopsis gracilis** (Mez) Pilger
On open sandy plain, spikes green, slender.
Shansha 2800 m, 45267.

* **O. munroi** Stapf ex Hook f.
On dry south facing barren slope, panicle green.
Kirting 3600 m, 45318.

* **Phragmites australis** (Cav.) Trin. ex Steud.
On moist irrigated north facing slope, panicle dark purple effuse.
Kishori 2600 m, 45937.

Poa annua Linn.
Under shade of Salices, panicle pale green.
Kirting 3000 m, 45317.

* **Setaria viridis** (Linn.) P. Beauv.
On dry sandy plain, spike purple.
Shansha 2800 m, 45264.

* **Stipa jacquemontii** Jaub. et Spach
On cliffs, spikelets purple.
Rasse 3400 m, 45336.

* **S. sibirica** (Linn.) Lamk.
Gregarious, forming uniform large lumps, panicle pale-green.
Rasse 3000-3600 m, 45326.

GYMNOSPERMS

EPHEDRACEAE

Ephedra gerardiana Wall. ex Stapf
On rock fissure, male flowers mostly shedding.
Roding 3000 m, 45312.

PINACEAE

Cedrus deodara (Roxb.) G. Don
Forming natural forest on north facing slope also along Maier Nala, with male and female cones.
Udaipur 2400 m, 45960.

Picea smithiana (Wall.) Boiss.
Forming natural forest on north facing slope, associated with *Pinus wallichiana,* with male and female cones.
Triloknath 26-3500 m, 45933, 45965.

Pinus wallichiana Jackson
Forming elegant forest on north facing slope mostly associated with *Picea smithiana,* with female cones.
Triloknath 26-3500 m, 45966.

CUPRESSACEAE

Juniperus communis Linn.
In *Pinus-Picea* forest undergrowth, always on north-facing slopes. Female cones present.
Rasse 34-3600 m, 45328.

J. polycarpos Koch.
Forming natural forest only on dry south facing slope. Male and female cones present.
Thirot 2600 m, 45352.

PTERIDOPHYTES

SELAGINELLACEAE

* **Selaginella sanguinolenta** (Linn.) Spring f. **indica** (Medic.) Alston

On north facing rock fissure. Cones present.
Kishori 2600 m, 41297.

ASPLENIACEAE

Asplenium septentrionale Hoffm.
Among boulders on west facing slope, sori brown.
Hinsa Nala 3300 m, 45902.

* **A. trichomanes** Linn.
Under shade of boulders, sori brown.
Hinsa Nala 3100 m, 45901.

PTERIDACEAE

* **Pellaea gracilis** Hook.
Under shade of boulders, sori with broad indusia.
Triloknath 3000 m, 45398.

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BHADRA WILDLIFE SANCTUARY AND ITS ENDANGERED ECOSYSTEM[1]

K. ULLAS KARANTH[2]

(*With a map*)

Remnants of Karnataka's once grand wildlife are now concentrated in a few forest pockets in and around Western Ghats. The little known Bhadra wildlife sanctuary, is one such area, potentially superior to many of our better known wildlife habitats. It has many features which make it a priority area for conservation and environmental management.

It is ironical that this area, which owes its uniqueness to an irrigation project, is now being threatened by ecologically ill-conceived developmental activities of rather dubious economic value.

INTRODUCTION

Karnataka has two major wildlife sanctuaries, at Bandipur and Nagarahole, which are well known for their fauna. Little-known Bhadra Wildlife sanctuary, not only far surpasses them in scenic beauty but is also potentially perhaps a better wildlife habitat. In this paper I make an attempt to fill the gap in our knowledge of the natural history of this fascinating area.

In 1951, a part of this area covering 252 sq. km. was constituted as "Jagara Valley Game Sanctuary". In 1972, "Bhadra Wildlife Sanctuary" was constituted by amalgamating Jagara Valley with the adjoining Lakkavalli forests. Bhadra sanctuary, split between Chickmagalur and Bhadravathi forest divisions, now has an area of 492 sq. kms. Its two component areas, Muthodi and Lakkavalli, are ecologically somewhat distinct and are almost conterminous with the two forest ranges of the same name.

It must be noted that considerable forest area, which forms a part of the sanctuary to the north of Bhadra reservoir, is in degraded condition and so do not hold wildlife in any appreciable numbers.

MATERIALS AND METHODS

I have visited the sanctuary in 1972, 73, 74, 78 and twice in 1980. Most of the information presented here was obtained during a status survey of the area carried out on behalf of World Wildlife Fund (Karanth 1978). I have covered almost the entire area on foot and by jeep, concentrating particularly on the favoured wildlife habitats.

Data on the population status of various wild animals were obtained by means of sightings and other supplementary evidence like tracks, calls, droppings, wallows etc. Additional information was obtained from forest department staff and other reliable local sources.

These data on the current status of wild mammals and some reptiles are shown in Table 1, on a comparative scale used by

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[1] Accepted August 1981.

[2] 268, 16th Main, Mysore-570 009.

Prasad *et al.* (1979). The bird identifications were based on Ali and Ripley (1968).

Location and Physical Features

Topography:

Bhadra sanctuary is located in Malnad region of Karnataka, about 50 km to the east of Western Ghats. (130° 30′ N., 75° 30′ E.).

An imposing outspur of the Western Ghats called Bababudan mountain range rises abruptly from the Deccan plateau forming a rough crescent shape here. Inside the 'crater' formed by them, the terrain is gently undulating (670-760 m elevation) but the mountains reach an elevation of 1200-1500 m. One of these peaks called "Mullaiahna Giri" is, at 1900 m, the highest in Karnataka. Inside the 'crater' another chain of hills called "Kagemane Giri" (Crow's house mountain-in Kannada) further divides the valley. The wildlife sanctuary essentially comprises of Muthodi area lying inside the crescent and Lakkavalli area spread on the northern outer slopes of Bababudans.

Boundaries and approaches:

The sanctuary is bounded on the north by Bhadra reservoir and cultivated plains, on the east and south by the coffee estates in the mountains and on the west by Bhadra river.

Muthodi is 32 kms away from Chickmagalur, and Lakkavalli about the same distance from Shimoga, both being connected by all weather roads. In addition the entire sanctuary is traversed by various forest roads, game roads and unmapped lorry tracks.

Climate:

The temperature in the valley ranges from 10°C to 32°C. Bulk of the rainfall occurs during the Southwest monsoon, between June and September. The annual precipitation is 2000-2540 mm and considerably higher than the 750-1000 mm generally received by the surrounding plains. This is primarily due to the great altitude, topography, vegetation and the consequent characteristic orography of Bababudans.

Water resources:

Bhadra river, originating in the Western Ghats, flows in a northeasterly direction along the foot of the western outer slopes of Bababudans. Somavahini river, draining the area inside the crater passes through a narrow gap in the mountain walls and joins Bhadra river at Hebbe.

Further downstream, Bhadra is dammed up at BR Project area forming a vast (about 200 sq. kms.) reservoir whose backwaters extend nearly 13 kms backwards and lap at the foot of the mountain range.

In addition to these major water sources, there are numerous streams and tanks scattered all over the area, quite a few of them being perennial sources.

Vegetation

The forests, of the valley floor and northern outer slopes, are of wet deciduous type. The inner slopes are covered by grassy downs with wet deciduous semi-evergreen sholas. On the outer edges of Lakkavalli area, the forests tend to intergrade into dry deciduous type. On the whole, Muthodi area is wetter and more verdant than Lakkavalli, particularly in the dry seasons.

The upper forest canopy contains valuable timber species like *Tectona grandis, Dalbergia latifolia, Terminalia tomentosa, Terminalia paniculata, Pterocarpus marsupium* and *Lagerstroemia lanceolata*. Somewhat uniquely, many fig trees (*Ficus* sp.) occur both independently as well as parasitical strangling figs. The most noteworthy feature of these forests is the vast continuous under canopy of bamboos, both *Dendrocalamus strictus* and *Bamboosa arundinacea* occurring extensively. On the forest floor, dense stands of reeds of *Oxytenathera* sp. and *Ochlandra* sp. can be seen at many places.

Where the canopy is closed, the forest floor is carpeted with wild ginger (*Globba* sp.) and where it is more open, the weed *Eupatorium* has been spreading rapidly.

Low lying areas of the valley floor are often marshy glades (called 'Hadlus') clothed in luxuriant growth of grasses. There are also some grassy banks on mountain slopes and along the edge of the backwaters.

Overall, from the point of view of fodder availability, the dry season 'pinch period' seems less severe in this area than in many other South Indian sanctuaries.

The natural vegetation has been considerably modified by human activity. Forest department plantations, mainly of teak, cover about 6% of the sanctuary area. The inner slopes of Bababudans is under private coffee plantations, sometimes encroaching into the forests. Quite a few of the 'hadlus' and river banks are occupied by paddy farmers.

However, inspite of these drawbacks, it apparently is still an excellent wildlife habitat, as shown by its faunal wealth.

WILDLIFE

The present status of wildlife, determined as accurately as possible, is presented in this paper. I have not taken into account the Amphibians, smaller reptiles, common rodents and Bats. (Table 1).

Reptiles:

Marsh crocodiles used to be found in Bhadra river in the past, though I could not get any information on their present status. Perhaps they have been decimated by dynamite using fish poachers who seem to be active. Monitor lizards are however fairly common. Rock Python and Hamadryad (King Cobra) both occur — the latter being confined to the Muthodi area.

Birds:

Apart from the great variety of species encountered, what impressed me was the sheer numbers of birds found all over the sanctuary, particularly in Muthodi area. While in many similar forests, one can walk considerable distances without coming across birds, in Muthodi every acre of the forest seems to be alive with birds! During the brief survey 99 species of birds were identified and half a dozen escaped identification. The total bird count for the sanctuary is likely to be over two hundred species.

Some of the birds noted during the survey were; Peafowl (*Pavo cristatus*), Grey Junglefowl (*Gallus sonneratii*), Red spurfowl (*Galloperedix spadicea*), Painted Bush Quail (*Perdicula erythrorhyncha*), Peninsular Turtle Dove (*Streptopelia orientalis*), Emerald Dove (*Chalcophaps indica*), Southern Green Imperial Pigeon (*Ducula aenea*), Jerdon's Imperial Pigeon (*Ducula badia*), Malabar Trogon (*Harpactes fasciatus*), Bluebearded Bee-eater (*Nyctyornis athertoni*), Malabar Grey Hornbill (*Tockus griseus*), Great Black Woodpecker (*Dryocopus javensis*), Pigmy Woodpecker (*Picoides nanus*), Blacknaped Oriole (*Oriolus chinensis*), Southern or Whitebellied Tree Pie (*Dendrocitta leucogastra*), South Indian Black Bulbul (*Hypsipetes madagascariensis*) and Rubythroated Yellow Bulbul (*Pycnonotus melanicterus*). Water birds like Darter (*Anhinga rufa*), Cormorants (*Phalacro-*

TABLE 1

PRESENT STATUS OF THE MAJOR ANIMALS OF BHADRA WILDLIFE SANCTUARY

Common Name	Scientific Name	Status		Favoured Localities
		Muthodi	Lakkavalli	
Bonnet macaque	*Macaca radiata*	2	2	Occurs around villages
Common langur	*Presbytis entellus*	4	4	All over
Slender loris	*Loris tardigradus*	2	2	
Tiger	*Panthera tigris*	3	2	Kagemanegiri, Tegara gudda
Leopard	*Panthera pardus*	2	2	
Leopard cat	*Felis bengalensis*	2	2	
Jungle cat	*Felis chaus*	2	2	
Rusty spotted cat	*Felis rubiginosa*	–	–	Part of its nominal range
Small Indian civet	*Viverricula indica*	–	–	” ” ”
Common Palm civet	*Paradoxurus hermophroditus*	2	2	
Brown Palm civet	*Paradoxurus jerdoni*	–	–	Its normal range
Common mongoose	*Herpestes edwardsi*	2	2	
Stripenecked mongoose	*Herpestes vitticollis*	2	2	
Ruddy mongoose	*Herpestes smithi*	–	–	Part of its range
Brown mongoose	*Herpestes fuscus*	–	–	Part of its range
Striped hyena	*Hyaena hyaena*	1	1	very rare
Jackal	*Canis aures*	3	3	All over
Indian fox	*Vulpes bengalensis*	–	–	Doubtful
Indian wild dog	*Cuon alpinus*	3	2	All over
Sloth bear	*Melursus ursinus*	1	2	Kavalapura
Common otter	*Lutra lutra*	–	2	Bhadra reservoir
Smooth Indian otter	*Lutra perspicillata*	–	–	?
Ratel	*Mellivora capensis*	–	–	Doubtful
Large brown flying squirrel	*Petaurista petaurista*	2	2	
Indian giant squirrel	*Rutufa indica*	4	4	All over
Indian porcupine	*Hystrix indica*	3	3	
Blacknaped hare	*Lepus nigricollis nigricollis*	3	3	All over
Elephant	*Elephas maximus*	3	3	
Gaur	*Bos gaurus*	4	4	
Fourhorned antelope	*Tetracerus quadricornis*	0	–	
Sambar	*Cervus unicolor*	3	3	All over the Muthodi Region
Spotted deer	*Axis axis*	2	3	Chandrana hadlu
Barking deer	*Muntiacus muntjak*	3	3	All over
Mouse deer	*Tragulus meminna*	2	2	
Wild pig	*Sus scrofa*	4	4	All over
Pangolin	*Manis crassicaudata*	2	–	
Python	*Python molurus*	2	2	
Hamadrayad	*Ophiophagus hannah*	2	0	Muthodi
Marsh crocodile	*Crocodylus palustris*	–	–	
Monitor lizard	*Varanus bengalensis*	2	–	

0 = Absent; — = No Information; 1 = Rare; 2 = Present; 3 = Frequent; 4 = Very Common.

corax sp.) and Large Egret (*Egretta alba*) were observed on the shallow backwaters. These with many half submerged trees and small islands, may attract more water birds at other times of the year. Potentially, this part of the sanctuary seems to be an excellant waterfowl habitat.

Mammals:

Common langur is abundant in the forests but Bonnet macaque is rather uncommon. Liontailed macaque is absent.

Tigers are not unusual, as frequent cattle kills are reported, particularly around Tegara Gudda and Kagemane Giri, where the Tigers retreat to avoid the disturbance caused by bamboo extraction. There may be about half a dozen tigers, though a census conducted in 1972 reported 12 tigers. Whatever their actual present population is, by properly managing the sanctuary, many more tigers will move in from the adjoining disturbed forest areas. This is one of the few areas where a breeding population of tigers can establish itself, and survive on natural prey.

Leopards are fairly common particularly in Lakkavalli area. In 1980 April, I saw a leo pard stalking langurs near Sukalahatti. Among other smaller carnivores, like cats, civets and mongooses, I could positively determine the existence of a few. However, some other species about which no information could be obtained are also likely to be present (Prater 1965).

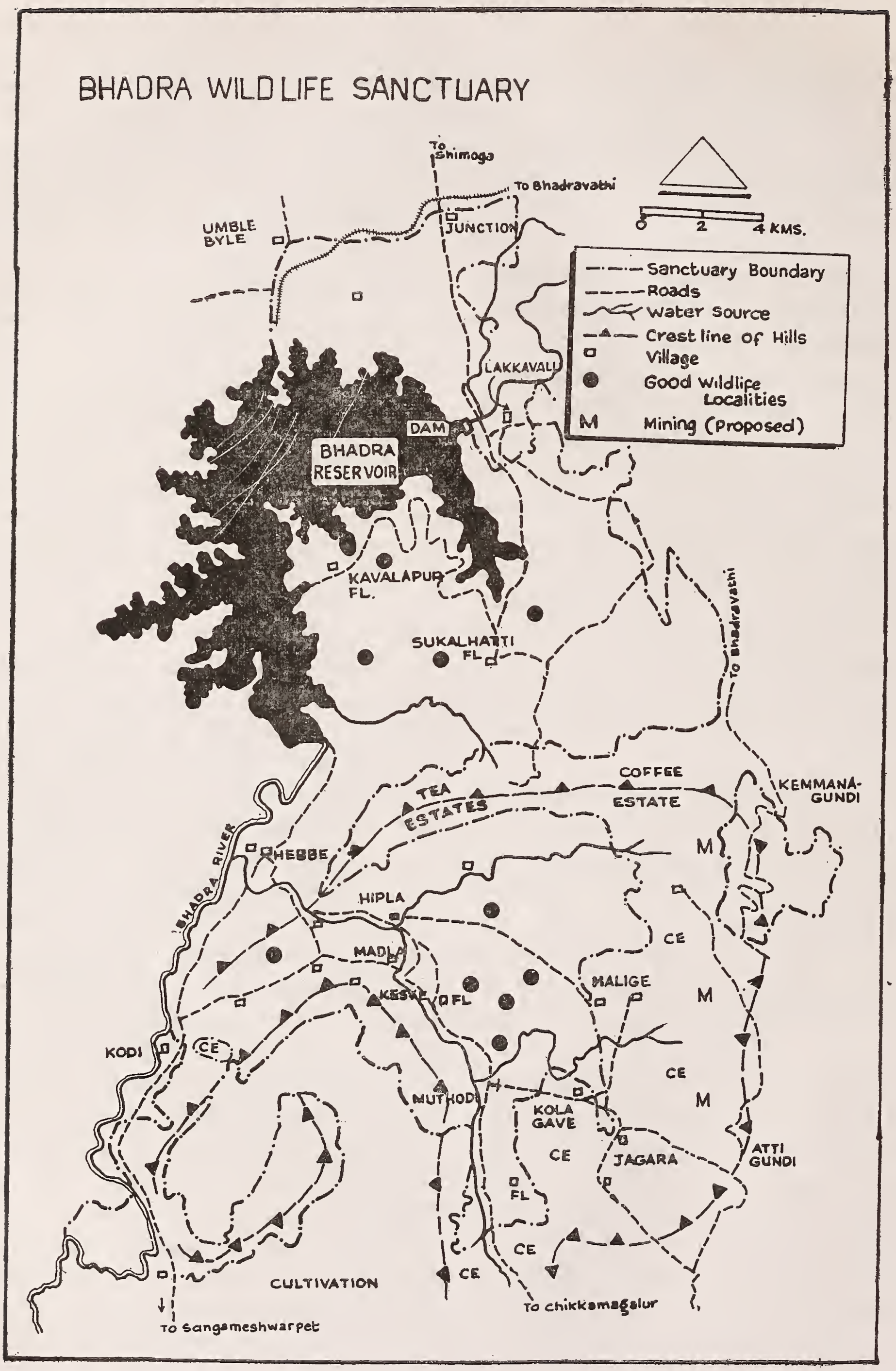
Striped hyenas are rare in the sanctuary. They seem to be more common in the drier plains and also used to be common in the heavy rainfall regions of Karnataka's coastal districts. But for some ecological reason they seem to avoid the wet deciduous forest tracts between the Western Ghats and the plains of Deccan. Wild dog tracks are found all over the area.

Sloth bears are rare and mostly confined to higher regions of Lakkavalli. There is a record of a bear being run over by a truck near Muthodi in the early seventies. This relative scarcity of bears here, when compared to the wet deciduous forests of Mysore plateau and evergreen forests of Western Ghats, is rather intriguing.

Giant squirrels are abundant and otters (*Lutra* sp.) are reported to occur in Bhadra reservoir.

Elephants occur in all parts of the sanctuary and seem to migrate locally between Muthodi and Lakkavalli depending to some extent on the ripening of paddy crops in the villages in and around the forests. During November 1980, for instance, most of the elephants seemed to be in Muthodi area.

Gaur certainly are the pride of Bhadra. Ecological suitability of the habitat coupled with the isolation of this area from the outbreaks of Rinderpest in 1968, seem to be the cause of their relative abundance. At a very rough guess, there may be around 1000 gaur here. They are certainly more numerous here than in many of the better known sanctuaries of our country. The large proportion of calves seen with the herds indicates a growing population. Also apparently, the carrying capacity of the habitat seems to be adequate for the gaur population since they do not raid crops here as in other parts of their range in Western Ghats. However, with the flowering/death of bamboo *Dendrocalamus strictus* in 1980, there will be a severe reduction of fodder availability to gaur and elephants. The death of bamboo and consequent opening up of the canopy will further increase fire hazards and accelerate the spread of *Eupatorium* weed, which in turn will further reduce fodder supply to the wild herbivores. Consequently,


BHADRA WILDLIFE SANCTUARY
To Shimoga
To Bhadravathi
0 2 4 KMS.
UMBLE BYLE
JUNCTION
Sanctuary Boundary
Roads
Water Source
Crest line of Hills
Village
Good Wildlife Localities
M Mining (Proposed)
LAKKAVALLI
DAM
BHADRA RESERVOIR
KAVALAPUR FL.
SUKALHATTI FL
To Bhadravathi
TEA ESTATES
COFFEE ESTATE
KEMMANAGUNDI
M
HEBBE
BHADRA RIVER
HIPLA
CE
MADLA
KESVE
FL
MALIGE
M
KODI
CE
CE
M
MUTHODI
KOLA GAVE
CE
JAGARA
ATTI GUNDI
FL
CE
CE
CULTIVATION
To Sangameshwarpet
To chikkamagalur

incidence of crop raiding and conflict with the farmers will also increase.

Sambar, spotted deer, barking deer, wild pig and mouse deer occur. The four-horned antelope does not occur in the sanctuary though its presence in the drier fringes of Lakkavalli cannot be entirely ruled out.

With a minimum of management, primarily in terms of antipoaching work and rational forestry, this splendid area will be an ideal habitat for a wide range of wild animals. Even now, Chandrana Hadlu, Dodda Hadlu, Nagara bhavi, Tegara Gudda, Kavalapura, Koramar gudda and Sukhalatti are excellent loclities for wildlife (see map).

Conservation and associated problems:

Dams and irrigation projects have generally spelled disaster for forests and wildlife in our country. Bhadra wildlife sanctuary so far seems to be a happy exception to this rule! Bhadra reservoir created in the sixties, completely cut off the two main roads running through this area, connecting Chickmagalur to towns in Shimoga district. As a result, the wildlife rich Muthodi valley became isolated and remained mercifully backward in terms of "development", as measured in our country. In the seventies, some dynamic officers of the State Forest Department armed with the Wildlife Protection Act (1972) did, to some extent, curtail the rampant poaching spree of earlier days. All these factors helped the wildlife populations to recover and the sanctuary improved gradually upto 1978.

Since then, however, human pressures are building up again and are likely to undo all the good work of the past.

1. The State Irrigation Department, is planning a dam across Somavahini river within the Muthodi valley, to divert its waters from the Bhadra reservoir to irrigate some other areas beyond the Bababudan mountains! If this project with its rather nebulous 'economic value' is executed, the forestry, agriculture and wildlife in the entire valley will be totally destroyed.

2. National Mineral Development Corporation's (NMDC) investigations indicate the feasibility of establishing magnetite ore mines on the inner slopes of Bababudans. These are visualised to be three times the size of the gigantic (Rs. 6000 million) Kudremukh Project. The environmental impact of these, on the local rainfall pattern (vital to the coffee crop), soil, siltation rate in Bhadra reservoir, forestry resources and wildlife have been ignored. However, due to problems connected with the international iron ore market, this particular threat seems to be off, temporarily.

3. State Government owned Mysore Paper Mills at Bhadravathi has started intensive extraction of bamboo in the sanctuary since 1978. So far, this extraction has been done in a most haphazard manner, with scarcely a thought for wildlife and its requirements. I feel, the wildlife sanctuary, or at least a sufficiently large part of it vital to wildlife, must be left unexploited. Of late, there seems to be some interest being shown by the paper mills in these things. Incidentally, this paper mill has gaur (bison) as its trade mark!

4. This wildlife sanctuary badly needs effective management in terms of anti-poaching work, fire protection, relocation of villages, control over grazing by domestic cattle and ill-conceived plans for 'wildlife tourism'. I was particularly unhappy to note that since 1979, antipoaching work seems to have declined and poaching seemed to be on the increase. Prompt payment of compensation for cattle killed by carnivores has also declined during this period, endangering tigers. All these

lacunae are likely to prove disastrous for the wildlife, in an area like this, surrounded as it is, by wealthy, trigger-happy planters and farmers.

CONCLUSIONS

It is hoped that various organisations concerned with conservation will take note of this and pressurise the State and Central Governments to take immediate steps to properly manage this area, ecologically vital not only for its wildlife but also to the rich agricultural systems and industries that depend on it.

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THE BEHAVIOUR OF THE NEST-GUARDING SALTWATER CROCODILE (*CROCODYLUS POROSUS*, SCHNEIDER) — A PRELIMINARY QUANTITATIVE STUDY[1]

H. R. Bustard[2] & S. Maharana[3]

(*With a text-figure*)

C. porosus usually guards the nest from one or more wallows. Nest-guarding is not a continuous process and in the present study on a captive female, occupied 75% of the total observation period. The crocodile retreated to the pool in the early hours of the morning and also during the day, presumably on thermoregulatory considerations. Absences were usually of short duration, mean 1.46 hours. Nest-guarding occurred from different sites. The implications for management are discussed.

INTRODUCTION

Nest-guarding in crocodiles is well known Cott (1971); Bustard (in press) for reviews and *C. porosus* is no exception Deraniyagala (1939); Bustard and Choudhury (in press) Choudhury and Bustard (1979). The Nile Crocodile (*C. niloticus*) is said to remain in attendance at or near the nest site during the whole three months incubation period (Cott 1971). Cott, however, also mentions females, whose nesting sites were exposed to the full heat of the sun, visiting the water to cool off (Cott 1961) as does Modha, (1967). Cott (1971) pointed out, "Little is known of the night life of females during the incubation period. A crocodile is nocturnally aquatic: yet females are certainly found occupying the grounds at night. However, no all-night observations on particular individuals have been made, and we do not know to what extent an all-night vigil is maintained."

Cott also produced evidence suggesting that the female Nile crocodile fasts throughout the incubation period. When the nest site was at a distance from the water, Cott referred to females being found in a comotose state as the incubation proceeds and concluded,
"It seems almost certain that such crocodiles remain on the rookery until hatching time, without once visiting the water."

It has been assumed, perhaps on the basis of the nest-guarding behaviour of the Nile crocodile, that the saltwater crocodile behaves similarly. Loveridge (1946) encouraged this view stating that the female *porosus* digs two wallows and remains in one or the other during the incubation period. Deraniyagala (1939) believed this to be the case in *C. porosus* and gave as corroborating evidence the fact that two nest-guarding crocodiles shot by him had empty stomachs. As pointed out by Choudhury and Bustard (1979) the stomachs of many crocodiles are empty in nature, (Cott 1961) so that this is not conclusive evidence

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that the nest-guarding females were not feeding.

During visits to many *C. porosus* nests, principally in Northern Australia and India, the senior author has noted presence or absence of the nest-guarding females. When absent, fresh tracks are often visible leading to the water, strongly suggesting that the adult crocodile has been in the vicinity (Webb *et al.* 1977; Choudhury and Bustard, in press),

In a study of nest predation Choudhury and Bustard (1979) pointed out the importance of knowing more about these absences from the nest — particularly their frequency and duration. This information has important implications in the field of management and conservation —it being necessary to be able to quantitatively assess the survival value of nesting-guarding behaviour to the progeny. No quantitative data on this aspect have been published.

MATERIALS AND METHODS

Information was obtained from a female saltwater crocodile reared from infancy in Nandankanan Biological Park, Orissa which laid eggs in each of the past three years (Acharjyo and Misra, in press). At the time the observations were made (August 1978) the female was stated to be 14 years old, and measured approximately 3 m. The enclosure measures 10.5 x 9.3 m, with a cement boundary wall 1.3 m high. A pool approximately 5 x 5 m, with maximum depth of 1.1 m, occupies between one-quarter to one-third of the total area. The substrate is red laterite with rubble and stones with sand in parts. Only one of the four trees in the enclosure is large, this is an 8.5 m Indian almond (*Terminalia catappa*), the other are rain trees (*Samanea saman*).

The female constructs her nest each year near the *Terminalia* tree, digs the wallow at a distance of 1.2 m from the nest and savagely defends the nest against intruders. Since there is no male, the eggs are infertile. It should be noted that unmated crocodiles like this may lay eggs in captivity and presumably also in the wild. This is probably one explanation for clutches occurring in nature which are completely infertile. The captive female guards the nest viciously driving off even human intruders throughout the entire incubation period.

Continuous, round the clock observations were maintained on the crocodile enclosure using a team of research assistants assisted by the junior author over a period of 77 hours commencing at 1900 hours on 3 August 1978.

Nest guarding was only scored from the pool when the crocodile remained near the poolside immediately adjacent to the nest.

RESULTS

Behaviour of the nest-guarding female

During the incubation season the behaviour of the female undergoes a pronounced change. Instead of its normal, lethargic disinterested posture, typical of zoo crocodilians used to the public, it is alert, closely observing any activity around its enclosure and at the same time keeping a watch over the nest, any animal entering the pool at such time is attacked. The keeper cannot enter the pool throughout the incubation period. Even when not specifically guarding the nest the female remains alert — the whole behaviour is markedly different from other times of the year.

Nest-guarding is used here to indicate that the female is in close proximity to the nest, lying either in the wallow adjacent to the nest, on the land beside and facing the nest, or in the pool with the head protruding from the water near the edge of the pool closest to the nest. In contradistinction, were it to lie along the edge of the land area adjacent to the compound wall or rest in the pool where this adjoins the outer compound wall where it is close to visitors (which is a common resting position at other times of the year) it would not be considered to be nest-guarding.

Nest-guarding

It was observed that nest-guarding was not a continuous process. However, during this period, nest-guarding occurred for 60 of the 77 hours (75.3% of the observed period). This behaviour is shown diagramatically in Figure 1.

A diurnal pattern can be seen in the activities (Figure 1). There was a retreat to the water in the early morning on all days (probably because of the cool night temperature, the pool being warmer). This again occurred in the early afternoon — the hottest part of the day — probably to cool off.

As indicated in the Figure these were differences between days. The crocodile was absent from the nest for $10\frac{1}{2}$ of the first 29 hours and subsequently, for $3\frac{1}{2}$ and $5\frac{1}{2}$ hours in each succeeding 24 hour day, a percentage absence of 36.2, 14.6 and 20.8 per cent respectively. With the exception of the first night, when perhaps nocturnal observation temporarily upset the normal behaviour pattern (the zoo closes to the visitors half an hour before

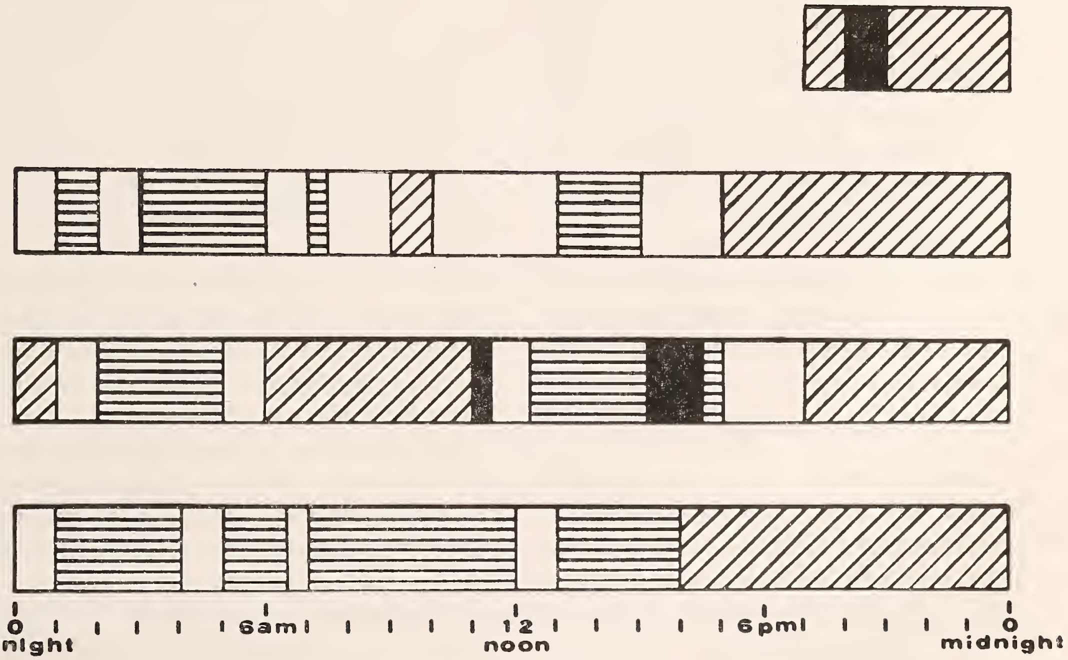

Fig. 1. The record commences at 1900 hours on 3 August 1978 (top right) and runs continuously from left to right (here split up into days for convenience) until midnight on 6 August. *Symbols*: open areas — crocodiles inside water not nest-guarding diagonal lines — nest-guarding from wallow; horizontal lines — nest-guarding from the pool; solid black — nest-guarding from land.

sunset), there was a prolonged period of nest-guarding of 8, 5 and 8 hours respectively in each of the succeeding days. On the first day the two longest continuous gaps in nest-guarding of the three day observation period were observed. These were 4 hours between 2100 and 0100 hours and 3 hours between 1000 and 1300 hours. However, absences were usually of short duration, about 1 hour. The mean for the 13 observed absences being 1.46 hours.

The longest period of continuous nest-guarding activity was 12 hours (1300-0100 hours) on the first day.

Nest-guarding stations

In the present study the crocodile guarded the nest from the wallow, from a position in the water immediately adjacent to the nest, and from the land other than in the wallow. The division of time spent between the various nest-guarding stations is also shown in Figure 1. A total of 29 hours of nest-guarding was carried out from the wallow close to the nest. This represented 49.2% of the total nest-guarding time. Twentyfive hours were spent guarding the nest from the water of the pool (42.4% of nest-guarding time) and only 5 hours (8.5% of the time) from the land other than the wallow.

DISCUSSION

This study shows that the nest-guarding female does not guard the nest continuously as is confirmed in nature by sometimes finding females absent from the nests, Webb *et al.* (1977); Bustard (in press); Bustard & Choudhury (in press); and Choudhury & Bustard (1979). However, since the present study is quantitative it provides insight into the amount of time the female may spend away from the nest.

The study also indicates the importance of the wallows in nest-guarding. Neill, as recently as 1971, has doubted that the saltwater crocodile digs wallows for nest-guarding purposes. However, presence of wallows is certainly the normal situation in both the Australian and Indian regions — at opposite ends of the geographic range, Deraniyagala (1939); Webb *et al.* (1979); Bustard (in press) Bustard & Choudhury (in press); Choudhury & Bustard (1979). These data strongly suggest that wallows occur throughout the range of the species, so that it is surprising that Neill had not encountered them.

In the present enclosure, it is probable that the pool (approximately 5 x 5 m) functions like a large wallow in nature. Both Webb *et al.* (1977); and Bustard & Choudhury (in press) have pointed out that there are two kinds of wallows, the latter sometimes resembling a pool, see Webb *et al.* (1977, Figure 2). If this hypothesis is accepted, then guarding from the wallow is seen to occur 91.1% of the total nest-guarding time — split almost evenly between the two types of wallows. As pointed out by Choudhury & Bustard (1979) the latter type of wallow has psychological advantages for the nest-guarding crocodile in that it can lie completely hidden. However, surveillance of the nest is probably better from the smaller wallows.

Both Webb *et al.* and Choudhury & Bustard have also pointed out the temperature (thermoregulatory) advantage of the wallow especially when the nest is exposed to direct sun for part of the day.

As assessment of the survival value of the progeny of nest-guarding depends on the efficiency of nest-guarding, of which length of absence from the nest — both the actual time at which absences occurred and also their duration — is an important factor. Observations in the wild have to be made extremely carefully since as pointed out by Cott (1971); Bustard (1978, in press); Bustard and Choudhury (in press) and Choudhury and Bustard (1979); crocodiles have learnt to fear man and generally nowadays do not protect their nests against man. However, there are ample data to show that this was not the case formally. Cott (1971); S. Kar (pers. comm.) and Bustard and Choudhury (in press) have data showing defence of the nest by the nest-guarding crocodiles in India today. It is perhaps important to stress that active nest-guarding does take place, since due to changed behaviour towards man, perhaps as a result of large-scale hunting, this may be easily overlooked. For instance, Webb *et al.* (1977) state, "It is not known whether *C. porosus* protect the nest against predators or not."

Crocodiles exhibit rapid learning (Bustard 1968) and it is most important to bear this in mind in the field during ecological studies, in order to keep interference with their normal behaviour to an absolute minimum.

The retreat to the pool in the early morning (night) hours and again in the heat of the day serves to underline the value of the larger type of wallow (with which it is suggested that the pool is synonymous) in thermoregulation. Undoubtedly, these cyclical movements are temperature-related.

In India, for instance, the water monitor *Varanus salvator*, perhaps the most serious non-human predator, is entirely diurnal. *Varanus* are important nest predators throughout the range of *porosus* as are wild pigs (true wild pigs or feral pigs as in Australia/New Guinea).

The prolonged period of nest-guarding, commencing around nightfall, is most significant as this is likely to be the time of greatest predation. Most animals are active in the evening hours (postcrepuscular) and it is at such times that potential egg eaters such as wild pigs, are most likely to be active. Conversely, retreat to the water during the heat of the day is not very serious if found to occur in nature as at such times most potential predators will also be lying up. Even diurnal predators such as *V. salvator* are likely to have a bimodal activity pattern with activity reduced or absent during the hottest hours.

During the nest-guarding period the female crocodile did not accept food daily as normal. There is indication of reduced appetite during the nest-guarding season.

There may have been differences in this captive situation compared to the wild state. However, disturbance effects, to the extent that these may have been present in an animal raised from infancy in the zoo, were most likely to interrupt the nest-guarding activity than strengthen it. The study shows a very well developed nest-guarding activity and absences from nest-guarding usually of short duration.

Management implications of maternal care in *C. porosus* — the nest-guarding phase should not be looked at in isolation — are discussed by Bustard & Choudhury (in press).

This preliminary study should be followed by an investigation over a longer period. It is hoped to conduct this during the 1980 nesting season. It would also be extremely valuable to parallel this work with a similar study conducted in the wild, as would be possible, for instance, in the Bhitar Kanika Saltwater Crocodile Sanctuary in Orissa.

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NOTES ON THE DISTRIBUTION OF CERTAIN RARE, ENDANGERED OR ENDEMIC PLANTS OF MEGHALAYA WITH A BRIEF REMARK ON THE FLORA[1]

R. R. Rao and K. Haridasan[2]

INTRODUCTION

In India, as elsewhere, the main causes for disappearence or threat to species are deforestation, afforestation with single species, and introduction and spread of foreign weeds (Rao 1979). With the disturbance of the natural habitat, a large number of species are threatened with extinction in India. A preliminary list of such endangered or threatened plants of the country has been recently compiled by Jain and Sastry (1980). Disturbance or clearence of natural vegetation in Meghalaya has especially rendered a large number of species rare or endangered, which were otherwise quite common at a time, when Flora of British India (Hooker 1872-97) was compiled. Recent studies by us on the flora of Meghalaya reveals a large number of such rare species with limited distribution in the state. Most of these species have not been reported by Jain and Sastry (op. cit.), and are therefore enumerated in this paper.

Location and general features of vegetation of Meghalaya

The state of Meghalaya lies between 25° 47′ and 20° 10′ N and 89° 45′ to 92° 47′ E in north-east India. The topography of the region is remarkable with undulating hills and steep slopes dissected by a network of rivers and their tributaries. These hills constituting the Sub-Himalayan ranges have access to the Himalayas, south China, Malay Peninsula through Burma and to Peninsular India. This has resulted in an astonishingly high floristic diversity.

The vegetation of Meghalaya has been categorised under the tropical and temperate types (Rao and Panigrahi 1961, Rao 1974). The tropical vegetation is confined to elevations up to 1800 m and comprises of (a) tropical evergreen and semievergreen forests along the high rainfall area of the southern belt (b) tropical deciduous forests occupying a major portion of the state and include such economically important species as *Tectona grandis, Shorea robusta, Pterocarpus marsupium* and others (c) subtropical pine forests (with *Pinus kesiya*) as the chief element over the high altitudes of Khasi and Jaintia hills.

The temperate forests in Meghalaya are chiefly confined to elevations between 1800 m to 1950 m. The dense patch of 'Sacred forests' at Shillong Peak and Mawphlang represent the true temperate forests, which show a high percentage of Himalayan elements. These sacred forests which are almost untouched due to religious beliefs represent the relict flora of the region and now act as sanctuaries for most of the rare, endangered or endemic plant species, which could have been probably fairly well distributed at one time.

The forests, in Meghalaya, have suffered

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heavy deforestation, mainly due to the evil practice of the so called 'jhumming' or shifting agriculture, which involves cutting down and burning of forests for agriculture for a period of 2 or 3 years and then following the area. In fact it can be said that there is hardly any area in Meghalaya which has not been jhummed at one time or other (except the sacred forests), with the result that the once luxuriant forest covered hills in the state, are now turned to grasslands and barren areas (Rao 1979). Comparative studies on the vegetation of sacred forests with that of adjacent areas can give us an indication of the extent to which the original forests might have been disturbed. Thus, deforestation in Meghalaya has resulted in the disappearence or has made rare a number of taxa. Such rare or threatened plants are now confined only to some sacred forests or to small, comparatively less disturbed pockets of vegetation in the state.

ENUMERATION OF RARE, ENDANGERED OR ENDEMIC PLANTS OF MEGHALAYA

The paper reports 70 species which are either rare, endangered or endemic in Meghalaya along with their habit, previous distribution and present occurrence in Meghalaya.

In the following enumeration of rare, endangered or endemic plants of Meghalaya, the species are alphabetically arranged. Categories[3] or status of taxa like Rare (R), endemic (E), endangered (EN) and vulnerable (V) are indicated and this is abbreviated as shown. Then follow the name of the family to which the species belong. This is followed by brief notes on distribution in India and in Meghalaya; and citation of voucher specimens, which are deposited in the Herbarium, North-Eastern Hill University, Shillong (NEHU[4]).

Acer laevigatum Wall. (R) (ACERACEAE).

Trees; Temperate Himalayas from Shillong Simla to Khasi hills; now confined only to sacred forests of Shillong peak and Mawphlang in Meghalaya. *Haridasan* 2393.

Agapetes obovata Hk. f. (V) (VACCINIACEAE)

Epiphytic shrubs; Khasi hills. Presently this species is confined only to sacred groves of Shillong peak, Mawphlang and Mawsmai. *Haridasan* 10005.

Apios carnea Benth. (R) (FABACEAE)

Twiners; Nepal and Khasi hills. We have recorded this only from Laitkor and Shillong peak forests. *Haridasan* 2395.

Apodites benthamiana Wt. (V) (OLACINACEAE)

Trees; Hooker reports this from western peninsula, Nilgiris and Meghalaya. We have noted this only from Mawlai in Khasi hills. *Haridasan* 5271.

Artocarpus lakoocha Roxb. (E) (MORACEAE)

Deciduous trees, throughout the north-east India, tropical Himalaya and Burma; we have recorded this only from Baghmara and Damra of Garo hills. *Haridasan* 4620.

Baliospermum micranthus Muell.-Arg. (V) (EUPHORBIACEAE)

Small trees; Hooker reports this from Khasi and Jaintia hills; presently confined to sacred forests of Mawsmai only. *Haridasan* 2898.

Berchemia floribunda Wall. ex Brandis (R) (RHAMNACEAE)

Shrubs; Tropical himalayas, East Bengal and Khasi hills (Hooker 1872-97). Very rare in Meghalaya, collected only once from Mawlai. *Haridasan* 5272.

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[3] The definitions for these various categories have been provided by Jain and Sastry (op. cit.).

[4] The abbreviation 'NEHU' is yet to find a place in 'Index Herbariorum'.

Butea monosperma (Lam.) Taub. (V) (Fabaceae)

Trees; Common throughout India and Burma extending to Malaya. Confined to Garo hills in Meghalaya; the population of this species has been considerably reduced. *Haridasan* 2799.

Campanumoea javanica Bl. (V) (Campanulaceae)

Twiners; Sikkim and eastwards to Burma and Java; now only recorded from Shillong, Nongstoin and Jowai. The population of this species is considerably reduced. *Haridasan* 3391.

Cardamine impatiens L. (R) (Brassicaceae)

Herbs; Temperate Himalayas, Sikkim to Bhutan; Asia and Europe. Collected only once in Shillong, very rare. *Haridasan* 4600.

Chirita hamosa R. Br. (E and EN) (Gesneriaceae)

Herbs; Hooker records this from Khasi hills, Burma and Malaya. Very rare in Meghalaya and the present report forms the second report from this region; confined to limestone forests of Balphakram in Meghalaya. *Haridasan* 10067.

Clerodendrum hastatum Lindl. (EN) (Verbenaceae)

Shrubs; Khasi hills and Sylhet (Hooker 1872-97); we have recorded this only once from Umsemlem. *Haridasan* 4568.

Coldenia procumbens L. (R) (Boraginaceae)

Herbs; Throughout Tropical India, Africa, Asia and Australia; but we have recorded only once as a weed in paddy fields at Baghmara of Garo hills. *Haridasan* 2796.

Connarus paniculatus Roxb. (V) (Connaraceae)

Trees; Sylhet and Khasi hills; now confined to Sacred forests of Mawsmai only; the population of this species has considerably reduced. *Haridasan* 4796.

Corylopsis himalayana Griff. (V) (Hamamelidaceae)

Shrubs; Khasi hills, Bhutan and S. China; now the population of this species has considerably reduced and is found along a narrow belt in the eastern part of the state. *Haridasan* 10253.

Dalhousiea bracteata Grah. (R) (Fabaceae)

Scandent shrubs; Eastern Himalaya, Assam and Sylhet. In Meghalaya very rare and collected only from Umtesar, Khasi hills. *Haridasan* 4684.

Daphniphyllum himalayense Muell.-Arg. (EN) (Daphniphyllaceae)

Trees; Temperate Himalaya, Mishmi hills and Sikkim and Khasi hills. We have recorded this only from the sacred groves at Shillong Peak, Mawsynram and Mawphlang; another species with a decreased population. *Haridasan* 4791.

Dipsacus asper Wall. ex DC. (V) (Dipsacaceae)

Herbs; Khasi hills; now the population of this species in Meghalaya is highly reduced. *Haridasan* 3392.

Elaeocarpus acuminatus Wall. ex Mast. (R) (Elaeocarpaceae)

Trees; East Bengal and Assam and Khasi hills; we have collected this only from sacred forests of Shillong Peak. The population of this species has also been reduced considerably. *Haridasan* 4297.

Elaeocarpus prunifolius Wall. ex Mast. (R) (Elaeocarpaceae)

This has been recorded from Sylhet and Khasi hills; but now it is seen only in sacred forests near Jarain in Jaintia hills. *Haridasan* 2055.

Endospermum chinense Benth. (V) (EUPHORBIACEAE)
Trees; Kanjilal *et al.* (1934-40) report that this is very common throughout the province; but now it is very rarely met with along the banks of rivers near Lailad, Khasi Hills. *Haridasan* 5296.

Engelhardtia wallichiana Lindl. (R) (JUGLANDACEAE)
Trees; Khasi and Jaintia hills; Now only few trees are noticed in Lailad of Khasi hills. *Haridasan* 3396.

Epipogeum roseum Lindl. (R) (ORCHIDACEAE)
Saprophytic orchids; Tropical Himalayas, Nepal, Sikkim and Khasi hills. In Meghalaya, extremely rare and we have collected this only once near Nongpoh. *Haridasan* 5281.

Erycibe peguensis Roxb. (R) (CONVOLVULACEAE)
Large climbers; Throughout India, Himalayas, Malaya and Australia; But we have collected this only from Mahadeo in Garo hills. *Haridasan* 4175.

Euonymus bullatus Wall. ex Lindl. (EN) (CELASTRACEAE)
Small trees; Khasi and Jaintia hills; Now found only at sacred forests in Mawsmai. *Haridasan* 4664.

Fraxinus floribunda Wall. (V) (OLEACEAE)
Trees, Temperate and subalpine Himalayas (Hooker 1872-97); in the entire Meghalaya we have noticed only a couple of trees near Malki in Shillong. *Haridasan* 4548.

Galeola falconeri Hk. f. (R) (ORCHIDACEAE)
Parasitic orchids; subtropical Himalaya and Sikkim; in Meghalaya, extremely rare and collected only once in Tura peak. *Myrthong* 1841.

Gastrodia exilis Hk. f. (R) (ORCHIDACEAE)
Saprophytic orchids; Hooker (1872-97) reports this from Khasi hills; there are no collections of this in the Assam herbarium; our collections from Raliang sacred forest forms a second report from this region. *Haridasan* 3387.

Goniothalamus simonsii Hk. f. & Th. (R) (ANNONACEAE)
Small trees; Hooker reports this from Khasi hills. Presently it is restricted only to the Lailad area of Nongkyllem reserve forest in Meghalaya. *Haridasan* 10288.

Hedera helix L. (V) (ARALIACEAE)
Climbers; Khasi hills, Bhutan Himalayas; in the present Khasi hills the population of this species is getting reduced due to forest clearings. *Haridasan* 2400.

Hymenodictyon excelsum Wall. (R) (RUBIACEAE)
Trees; W. Himalaya, Nepal and Bangla Desh; we have recorded this only once in Tura peak. *Haridasan* 4621.

Ilex khasiana Purkaystha (V) (AQUIFOLIACEAE)
Trees reported from Khasi hills; now there are only a couple of trees in the Shillong peak and Elephant falls area. *Haridasan* 4799.

Ilex venulosa Hk. f. (R) (AQUIFOLIACEAE)
Another species reported from Khasi hills; now very rare in Khasi hills as its habitat near Laitlyngkot has been destroyed. *Haridasan* 3393.

Lasiobaema scandens (L.) de Wit (R) (CAESALPINIACEAE)
Lianas; Eastern Bengal, Sikkim, Burma and

Malaya. An extremely rare plant in Meghalaya; collected from Daveband, Maheshkola in Garo hills (only one plant was noticed). *Haridasan* 10099.

Leptodermis griffithii Hk. f. (V) (RUBIACEAE)
Shrubs reported from Khasi hills; presently it is seen only in Upper Shillong where it is facing extinction. *Haridasan* 2397.

Leucosceptrum canum Sm. (R) (LAMIACEAE)
Small trees; Temperate Himalaya, Bhutan and Khasi hills; presently confined only to some pockets in Shillong. *Haridasan* 4598.

Litsea elongata Wall. (R) (LAURACEAE)
Trees; Assam, Khasi and Jaintia hills; now mostly confined to sacred forests at Shillong peak and Mawphlang. *Haridasan* 2394.

Manglietia insignis Bl. (R) (MAGNOLIACEAE)
Trees; Nepal and Khasi hills; presently the species is confined only to sacred forests in Meghalaya. *Haridasan* 2396.

Medinilla rubicunda Bl. (V) (MELASTOMACEAE)
Epiphytic shrubs; sub-Himalayan ranges, Sikkim eastwards to Khasi hills. Now restricted only to sacred forests in Meghalaya. *Haridasan* 4300.

Meliosma pinnata Roxb. (R) (SABIACEAE)
Trees; Sikkim, Himalayas and Khasi hills; the only collection we have is from Shillong Peak, where a solitary tree exists. *Haridasan* 4218.

Melodorum rubiginosum Hk. f. & Th. (E) (ANNONACEAE)
Climbers; Assam, Sylhet and Burma; only present in Rongrengiri Reserve forest of Garo Hills, where the population of the species is highly reduced. *Haridasan* 9948.

Michelia punduana Hk. f. & Th. (R) (MAGNOLIACEAE)
Hooker and Thomson (1872) report this species from Khasi hills; we have not been able to collect anywhere in Khasi hills, but our collection is from Jaintia hills. *Haridasan* 2834.

Monotropa uniflora L. (R) (MONOTROPACEAE)
Saprophytic herbs; Temperate Himalayas, Khasi hills and Japan. Extremely rare in Meghalaya and found only in sacred grooves of Shillong peak and Mawphlang; this species is also at risk now. *Haridasan* 2399.

Munronia pinnata (Wall.) Harms. (R) (MELIACEAE)
Herbs, Eastern Himalaya, Sikkim, Khasi hills and Nilgiris. The population of this species is extremely low due to forest clearings. *Haridasan* 2791.

Nepenthes khasiana Hk. f. (E) (NEPENTHACEAE)
This is the pitcher plant of Meghalaya; one of the endemic plants struggling for survival in small pockets in Jarain, Maheshkola, and Baghmara and other places in the southern belt of the state. *Haridasan* 3398.

Ochna squarrosa Planet. (V) (OCHNACEAE)
Trees, Burma, Andamans and Khasi hills; very rare in Meghalaya and collected only from Balphakram sanctuary. *Haridasan* 947.

Parkia roxburghii A. DC. (R) (MIMOSACEAE)
Trees; Assam, Sylhet, Burma and Malay Peninsula. In Meghalaya very rare due to jhumming and indiscriminate felling; only few plants are noticed along the southern part of Garo Hills, Garampani and Nongpoh. *Haridasan* 4280.

Paurthiaea arguta Decne (R) (ROSACEAE)

Trees reported from Khasi hills; presently confined to Shillong peak only, where only a few trees are present. *Haridasan* 4529.

Pentapterygium rugosum Hk. f. (R) (VACCINIACEAE)

Epiphytic shrubs; Bhutan and Khasi hills; now confined to sacred forests in Khasi hills. *Haridasan* 3397.

Photinia integrifolia Lindl. (R) (ROSACEAE)

Trees; Himalayas, Nepal, Sikkim and Khasi hills; presently found only in Cherrapunji in Khasi hills. *Haridasan* 3394.

Phyllanthus longiflorus Heyne (R) (EUPHORBIACEAE)

Shrubs to herbs; southern India. Recently collected from Balphakram sanctuary, rare. (Rao *et al.* 1981). *Haridasan* 4156.

Pittosporum humile Hk. f. & Th. (EN) (PITTOSPORACEAE)

Shrubs; Khasi hills. We have recorded this from Barapani and Mawlai near Shillong. *Haridasan* 10193.

Polygala tricholopha Chodat (V) (POLYGALACEAE)

Scandent shrubs; Assam, Cachar Hills; extremely rare in Meghalaya and getting drastically reduced; collected only once from the sacred forests of Mawsmai, which forms the first report after 1931 (Haridasan *et al.* 1981) *Haridasan* 5959.

Porana racemosa Roxb. (R) (CONVOLVULACEAE)

Climbers; Assam, Andamans and Eastern Peninsula. In Meghalaya very rare and found only in Shillong peak and Raliang. *Haridasan* 3390.

Rhododendron formosum Wall. (R) (ERICACEAE)

Ornamental shrubs; Bhutan and Khasi hills; very rare in truly wild condition in Meghalaya; only once collected near Jakrem. *Haridasan* 4184.

Salix tetrasperma Roxb. (V) (SALICACEAE)

Trees; Himalayas, Assam and eastwards to Java; now very rare and only a few isolated trees were seen in Khasi hills. *Haridasan* 3395.

Schima khasiana Dyer (R) (THEACEAE)

Trees; Khasi hills; now found only in Shillong peak, Mawphlang and Sohrarim. *Haridasan* 4277.

Schizandra neglecta Sm. (R) (SCHIZANDRACEAE)

Climbers; Temperate Himalayas, Sikkim and Khasi hills; now extremely rare in Khasi hills and we have located only a few plants in Upper Shillong. *Haridasan* 4274.

Sophora acuminata Benth. ex Baker (R) (FABACEAE)

Shrubs; Bangladesh, Eastern Himalayas, Khasi hills and Assam. We have recorded this plant only from the sacred forests at Mawsmai, where only a few plants were noticed. *Haridasan* 4663.

Strobilanthes acrocephalus T. Anders. (R) (ACANTHACEAE)

Herbs reported from Khasi hills; we have recorded this only from Shillong *Haridasan* 2793.

Strophanthus wallichii A. DC. (R) (APOCYNACEAE)

Climbing shrubs; Khasi hills, Chittagong, Burma. In Meghalaya, now extremely rare and collected only once from Lailad, Khasi hills, where a solitary plant was noticed. *Haridasan* 5289.

Stylidium kunthii Wall. ex Cl. (R) (STYLIDIACEAE)

Herbs; Bangladesh, Burma, Sikkim and Khasi hills; a recent report (Haridasan *et al.* op. cit.) from Garo hills is the only collection after about 100 years from this region. *Haridasan* 4108.

Thunbergia coccinea Wall. (R) (ACANTHACEAE)

Climbers; Himalayas, Bhutan, Assam and Khasi hills. We have collected this only from the sacred forests at Mawsmai. *Haridasan* 2398.

Tupidanthus calyptratus Hk. f. & Th. (R) (ARALIACEAE)

Shrubs; Khasi hills; we have not been able to record this from Khasi hills. Our only collection is from Balphakram in Garo hills. *Haridasan* 2738.

Ulmus lanceifolia Roxb. (V) (ULMACEAE)

Trees; sub-tropical Himalayas, Sikkim, Khasi hills and eastwards to Burma; during our studies we have recorded this only from Lailad in Khasi hills. *Haridasan* 10224.

Unona longiflora Roxb. (V) (ANNONACEAE)

Scandent shrubs; Assam, Khasi hills and Chittagong; now confined to Tura peak (Garo hills) and Nongkyllem reserve forest in Khasi hills. *Haridasan* 10257.

Uvaria hamiltonii Hk. f. & Th. (V) (ANNONACEAE)

Climbers; Sikkim, Bihar, Orissa and Assam. The population of this species is decreasing rapidly; collected only once from Rongrengiri forest in Garo hills. *Haridasan* 5266.

Uvaria lurida Hk. f. & Th. (V) (ANNONACEAE)

Another rare climber in the state; only recorded once from Balphakram in Garo hills. *Haridasan* 10098.

Xylia dolabriformis Benth. (R) (MIMOSACEAE)

Trees; Western Peninsula, Burma and Singapore; extremely rare in Meghalaya and confined to Nongkyllem reserve forest in Khasi hills. *Haridasan* 10209.

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POLLUTION, FISH MORTALITY & ENVIRONMENTAL PARAMETERS IN LAKE NAINITAL[1]

S. M. DAS[2] AND JYOTSNA PANDE[3]

Indepth studies on pollution, fish mortality and waterborne human disease have revealed severe pollution in the entrophied Himalayan lake Nainital, India, as evidenced by physico-chemical and biological indicators. The hazardous effect on fish life has been evidenced by mass fish mortality every winter and decimation of fish population of the lake (mainly Mahseer, *Tor tor, T. putitora;* the common carp, *Cyprinus carpio;* the Himalayan trout *Schizothorax richardsoni* and the forage fish, *Puntius* species — *conchonius, sophore* and *ticto*).

Metallic pollution of the lake is high, as estimated by atomic absorption spectrophotometry. Bacteriological studies have also revealed contamination by *Escherichia coli* and other coliforms; causing human diseases in Nainital, as confirmed by records of Govt. and other hospitals in Nainital and Weibel *et al.* (1964).

INTRODUCTION

Lake Nainital is a huge *cul-de-sac,* situated at an altitude of 1938 m, asl, (29° 24′ N, 79° 23′E). It is a beanshaped lake divisible into a large Mallital and small Tallital basins. The lake is 1433 metres long and 463 metres broad, the depth ranging from 6 to 24 metres. Its area is about 48.78 hectares, and the lake capacity (volume when full) 10,772,236/000 Cu M. It is an eutrophic lake moving towards dystrophic condition.

In India, recent studies on aquatic pollution are by David (1959), Ray (1968), Jhingran (1970), Lohani (1970), Saxena *et al.* (1972), Rana & Kumar (1974), Verma and Dalela (1975), Hussaini (1976) and Agrawal & Raj (1978). However, no scientific investigation into the nature, extent and effects of pollution on fishes, lake life and man, have been carried out in the past for Himalayan lakes except for Dal lake (Das 1967a, 1969, 1970, 1971, 1973; Zutshi & Vass 1978), and lake Nainital (Das 1978, Das & Pande 1978, Das & Khanka 1979, Das & Upadyaya 1979).

In the present investigation some of the physical, chemical and biological factors affecting fish and man have been studied in lake Nainital.

MATERIAL AND METHODS

Detection of pollution was done by five methods:

(a) Physical — colour, odour, temperature and turbidity;

(a) Chemical — pH, O_2, CO_2, alkalinity, PO_4-P, NO_3- N, NH_3- N, BOD and DOM;

(c) Biological — High population of pollution indicators and fish mortality;

(d) Quantitative analysis of metal pollution by atomic absorption spectrophotometer;

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(e) Estimation of bacterial pollution by assessing Coliforms and *E. coli.*

The physico-chemical parameters were estimated according to the standard methods given by ISI (1963), WHO (1975), FAO (1967), APHA (AWWA) (1975), Golterman (1969) and Schwoerbel (1970).

The biological indicators of pollution were estimated according to the methods of Kolkwitz (1950), Bick (1963), Sladecek (1963), Hynes (1966), Kolkwitz & Marson (1967), Hart & Fuller (1974) and McCaull & Crossland (1974).

One thousand dead fishes were collected in December & January by random sampling after fish-kill, which were identified as adult *Puntius* (3 species), *Cyprinus carpio* juveniles and *Schizothorax richardsoni* adult and juveniles.

Some Nainital data have been compared with those of oligotrophic lake Bhimtal (Tables I and II), in order to show the contrast between the eutrophic and the oligotrophic lakes. Similarly, the results have been compared with eutrophic polluted lakes in Western countries.

OBSERVATIONS AND RESULTS

Polluting matter is brought into Nainital lake through 24 inlet channels observed around the lake. Fifteen of them are seasonal and carry mainly erosion silt and minerals into the lake in the rainy season (July to September); while the other 9 are permanent municipal nallahs or channels which bring highly polluted water from the Nainital town and the lake environs. The effluents falling into the lake contain domestic wastes, general garbage, organic matter, detergents, chemicals from the laboratories around the lake, and also some sewage from the densely populated parts of the town.

Physico-chemical Parameters:

The ranges of physical parameters of Nainital (for the year 1978-79) are as follows:

Temperature varied from 10.5°C (January) to 25.0°C (June); colour changed from brownish green (January-February) to dark green (May-June), yellowish green (July, August, September), and finally bluish green

TABLE I

PERCENTAGE OCCURRENCE OF MAIN GROUPS OF ZOOPLANKTON (1978-79)

	Nainital			Bhimtal		
Months	Rotifers	Copepods	Cladocerans	Rotifers	Copepods	Cladocerans
1978						
October	4.98	92.00	2.00	1.32	60.00	26.00
November	7.90	91.00	0.80	12.00	58.00	19.00
December	1.10	98.00	0.50	0.80	60.00	15.00
1979						
January	Rare	100.00	Rare	Rare	56.00	25.00
February	Rare	100.00	Rare	Rare	74.00	24.00
March	61.00	38.00	Rare	9.00	73.00	14.00
April	40.00	59.00	Rare	3.00	24.00	8.00

(November), while December-January it is brownish green to rust colour. The odour varied from strong methane (May) to fishy and H_2S (November, December, January); Turbidity (Secchi) recorded as 100 cm (August) to 178 cm (December); pH ranged from 6.8 (January) to 8.9 (July-August).

In the chemical parameters, DO ranged from 0.8 mg/l (December) to 12.3 mg/l (May); CO_2 from zero (during six warm months) to 18.6 mg/l (December-January); alkalinity from 270 mg/l (June) to 330 mg/l (February); PO_4-P from 0.02 mg/l (March) to 0.05 mg/l (June); No_3-N from 0.12 mg/l (July) to 0.64 mg/l (April); NH_4-N 0.017 mg/l (July) to 0.52 mg/l (December); Cl from 26.5 ppm (July) to 35.5 ppm (January); DOM from 26.5 ppm (March) to 55.5 ppm (January); BOM (bottom organic matter) 60 mg/g (August) to 190 mg/g (January), which forms a thick organic mat throughout the year. It is evident from the parameters that most of the values, hazardous to lake life including fishes, lie in December-January, the two months when severe fish mortality was found to occur.

If we compare these physico-chemical parameters of lake Nainital with those of lake Bhimtal, the contrast in lake status becomes evident. Bhimtal turbidity (Secchi) ranges from 385-500 cms. when compared with 100 to 178 cms. of lake Nainital. DO values are also high throughout the year, being 8.1 mg/l to 13.6 mg/l; CO_2 nil to 4.0 mg/l only; pH 7.7 to 8.6; alkalinity low (26.6 to 56.7 ppm); whereas NH_4-N even in the winter is nil. Of special significance is the near absence of BOM in lake Bhimtal, while in Nainital, there is a thick organic bottom mat. All these data show that Bhimtal is oligotrophic but Nainital is eutrophic and polluted.

Metallic environmental pollution is a significant factor in lake Nainital (Table IV). The high values of manganese, lead, zinc, potassium and calcium, specially in the sediments, are environmental factors detrimental to fish.

A. *Zooplankton and Pedon*:

These have been recorded by Das (op. cit.),

TABLE II

PERCENTAGE OCCURRENCE PEDON

Months	Nainital %				Bhimtal %				
	Tubificids	Leeches	Chironomids	Molluscs	Larvae May fly	Aq. Insects	Cladocera	Crab	Molluscs
1978									
May	22	5.0	50	15	25	15	10	2	2
June	25	3.5	55	15	30	25	20	3	2
July	13	5.0	13	4	40	15	30	5	3
August	40	6.0	30	5	20	15	10	2	3
September	20	5.0	50	2	30	10	20	2	1
October	15	5.0	30	6	10	10	30	2	12
November	20	1.5	30	5	Rare	15	50	3	5
December	15	0.5	25	17	Rare	30	40	5	5
1979									
January	10	1.5	70	10	7	10	40	2	5
February	12	2.0	70	15	6	10	54	3	6

Das & Pande (op. cit.) and Das & Upadhyaya (op. cit.), which exhibit many biological indicators of pollution thriving in the lake, some of which are present during November-December along with *Anacystis* bloom. Much of the plankton dies off during December-January, when only Chironomids and molluscs remain in numbers (Table II). The quantitative percentage composition of zooplankton also suffers, since, except for Cyclops swarms, only a few species of copepods remain in moderate numbers during winter. The rotifers and cladocerans are also decimated (Table I).

For example, the chief zooplanktons recorded by the authors on January 9, 1979 (along with fish-kill) were *Euglena, Bursgria* (Protozoa); *Philodina, Rotifer, Colurus* (Rotifera); *Cyclops, Simocephalus, Diaptomus* (Crustacea); *Chironomus, Forcipomyia* (Insecta); *Rhabdolaimus, Dorilaimus* (Nematoda).

The percentage occurrence of Pedon (Table II) also shows radical differences between Nainital and Bhimtal, the former having higher percentage of Chironomids (pollution) and the latter higher cladocera (oligotrophic).

B. *Phytoplankton and Algae*:

Das & Upadhyaya (op. cit.) recorded dominance of blue greens (Cyanophyceae) during autumn, when *Anacystis* was in bloom. But during winter fish-kill most *Anacystis* died and only *Chroococcus* was abundant. These also died at December end and early January, forming a soupy mass along with other dead plankton. The scant algae left were the rope-like *Rhizoclonium, Ulothrix, Spirogyra* and remnants of *Anacystis* and *Chroococcus.*

The diatoms were represented by moderate population of *Scenedesmus, Cymbella* and *Synedra* (pollution indicators) along with sparse population of *Nitzchia* and *Meridion.* The spring and summer diatoms were, however, dominated by *Cymbella, Rhoicosphenea, Pinnularia, Synedra, Fragilloria* and *Navicula,* The phytoplankton population in Nainital lake was at its peak in August, with the green algae *Chlamydomonas, Clorterium* and *Endorina* as dominant phytoplanktons (60%). But another peak was observed in October, when 82% of the phytoplanktons consisted of *Microcystis,* (*Anacystis*) and *Anabaena.* The *Microcystis* bloomed in autumn (November) and died in winter (December, January), causing organic water pollution and secretion of toxins that are hazardous to fish. This was succeeded by the micro-plankton bloom of *Chroococcus,* imparting a soupy rust colour to the lake accompanied by high winter fish kill. The summer filamentous algae (*Spirogyra, Oscillatoria, Rhizoclonium* etc.) also underwent death and decay during winter season causing further organic pollution.

C. *Bacterial pollution*:

The coliform bacteria and *E. coli* have been worked out qualitatively and quantitatively for the first time in lake Nainital. These bacteria are not only indicators of sewage pollution but are hazardous to man and animals if they drink the lake water. The constant high counts of coliform and *E. coli* (Table III) signify that there is constant entry of faecal matter into the lake through the many nullahs (since *E. coli* would die within 10-15 days when exposed to air and sun in the open lake). Thus, the high values of *E. coli* signify continuous faecal contamination of the water in the zone of sepsis (Station I). For instance, even outside the zone of sepsis (100 metres away, Station II), the *E. coli* values ranged from 0.05 x 10^1 to 9.70 x 10^4, which is higher than the permissible limits (Prescott 1970; Geldrich 1970).

TABLE III

TOTAL COLIFORMS AND *E. coli* OF NAINITAL LAKE WATER

Months	STATION-I Coliforms MPN/100 ml	STATION-I *E. coli* MPN/100ml	STATION-II Coliforms MPN/100 ml	STATION-II *E. coli* MPN/100 ml
March	6.70×10^4	6.70×10^4	0.22×10^4	0.09×10^4
April	17.00×10^4	13.80×10^4	1.25×10^4	1.22×10^4
May	50.50×10^4	50.50×10^4	0.68×10^4	0.25×10^4
June	12.00×10^4	4.30×10^4	4.60×10^4	4.60×10^4
July	17.25×10^4	13.00×10^4	1.60×10^4	1.00×10^4
August	18.60×10^4	4.69×10^4	15.00×10^4	4.00×10^4
September	21.30×10^4	13.60×10^4	12.70×10^4	9.70×10^4
October	25.50×10^4	22.50×10^4	4.85×10^4	2.17×10^4
November	18.60×10^4	18.60×10^4	0.80×10^4	0.20×10^4
December	14.25×10^4	11.25×10^4	2.50×10^4	0.67×10^4
January	9.20×10^4	4.30×10^4	0.11×10^4	0.05×10^4
February	7.80×10^4	4.10×10^4	0.15×10^4	0.07×10^4

It has been calculated in western countries (McCaull & Crossland (op. cit.) that decomposing organic matter from cities and towns can be calculated at 1 Kg/man/day. Even with a population of 50 thousand around the lake Nainital, this amounts to an input of 50 thousand kilos of DOM and SOM into the lake per day. This means an addition of about 18 million Kgs. of DOM and SOM into the lake per year. Even if a small part of this accumulates without being oxidised at the bottom (forming a BOM mat), the pollution status of the lake becomes self evident and explanatory.

Siltation :

Rapid silting of lake Nainital is another cause of lake pollution and shallowing. Fifty years back, the lake was 29 metres deep at the centre (Neville 1922). Today it is only 24 metres (Das & Khanka 1979). Silt enters the lake through almost all the 24 nullahs but specially from Mallital and North Mall road side, where small peninsulas of debris, rubble and silt project into the lake today. With high siltation the suspensoids (suspended organic matter) get coated round the silt particles and settles down to the bottom, preventing natural oxidation, since DO in bottom water never rises above 5-6 mg/1 and becomes 0.08 mg/l during winter. The bottom water and mud, even in mid-lake, is highly odorous with strong H_2S and Methane odours. This has already been observed in zones of immediate pollution in the lake (Das 1978), and during the present investigations.

Fish mortality :

High Winter fish mortality occurs every winter in lake Nainital, the majority of about 60,000 fishes killed during December 1978 to January 1979, being *Puntius* species. But some *Cyprinus carpio, Schizothorax richardsoni* and their juveniles also died. The once famous Mahaseer (*Tor tor, T. putitora*) are now extinct in lake Nainital, probably due to pollution.

The causes of high winter fish-kill has been found to be depletion of Oxygen in bottom waters, when anaerobic bacteria take over the process of decomposition of BOM, releasing foul smelling H_2S, Methane and Ammonia (Aerobic bacteria evolve only CO_2 when organic matter is decomposed in the presence of oxygen). These gases not only deplete oxygen in water but are toxic, killing most of the plankton, algae and zooplankton in the lake. The dead plankton and SOM clog the gills of the fishes causing asphyxiation. The DO content is reduced to almost zero/mg/l in which no fish or plankton can live.

Fish diseases are common in lake Nainital due to attack of fungi-*Saprolegnia* & *Achlya;* the protozoans *Chilodenella, Costia, Trichodina, Ichthyophthirius,* and *Myxosporidium.* The trematode—*Dacrylogyrus;* the leeches—*Hemiclepsis* and *Glossiphonia;* and the crustacean *Argulus.*

Discussion

The most important factors responsible for eutrophication of fresh water lakes are Phosphorus (PO_4-P) and Nitrogen (NO_3-N) (McCaull & Crossland 1974). Lake Nainital receives about 63% PO_4-P from municipal and urban run-off; consisting of sewage, domestic wastes and detergents; 30% from horse dung, Kitchen garden and minor crop fertilizers; 2% from precipitation; and 4% from surface ground waters in the form of springs. The NO_3-N comes to about 50% from the ground sub-surface water; 20% by precipitation; 10% by municipal and urban run-off; 10% from chemical laboratories and 10% from minor crop and garden fertilizers. It has been calculated (Edmondson 1970) that about 93% P in polluted lakes and over 30% N are due to human activities. The high P and N values in lake Nainital have caused rapid eutrophication and algal blooms of myxophyceae. Excess N may cause Methaemoglobinemia — a health hazard to man, and even injurious to fishes.

Overdose of Nitrogen and Phosphorus, the very nutrients essential for the growth of plankton and aquatic plants, results in high eutrophication, algal blooms and explosion of macrophytes (Landner 1975). Excess PO_4-P comes from detergents and sewage both of which enter lake Nainital in large amounts today. Excess NO_3-N also comes from chemical effluents and aerobic decomposition of organic lake sediments. Excess PO_4-P is also released by breaking up of the iron salts layer at bottom mat (since the hypolimnion is anaerobic) eleven times faster than when O_2 is present (McCaull & Crossland 1974). This appears to be the case also in Nainital where the bottom water (6-24/m) smells strongly of H_2S, indicating anaerobic decomposition of BOM.

It will not be out of place to compare lake Nainital with other polluted lakes in Western countries. Lake Zurich (McCaull & Crossland 1974) has the deep lower basin (50 m) highly polluted, while the shallow upper basin (14 m) remains unpolluted. This pollution of the lower basin started only 50 years back on account of increase of human habitations around the basin, exactly as has happened in lake Nainital during the same period. Fish population in the polluted Zurich basin has become depleted and only coarse fishes are present; while the upper basin still has fine fish.

Lake Lago-da-Orta (Das 1973) is a dead lake today due to copper mining in lake environs and copper poisoning of all lake life. The Nainital lake sediments have accumulated more than 2159 mg/kg. of Lead and 60 mg/kg. of Copper, as in our values (Table IV).

TABLE IV

CONCENTRATION OF HEAVY AND ALKALI EARTH METALS IN LAKE NAINITAL

Metal	Water mg/l		Sediments mg/kg	
	Minimum	Maximum	Minimum	Maximum
Copper	0.0008	0.0155	19.3639	60.6225
Cobalt	0.0079	0.0202	5.5954	12.9892
Lead	0.0202	0.0886	71.3645	268.9156
Manganese	0.1893	1.1951	769.2307	2158.8362
Zinc	Nil	0.0057	49.4151	152.1322
Thalium	0.2105	0.4429	78.5340	149.8814
Lithium	0.0055	0.0087	9.0909	18.2183
Sodium	0.7893	1.1093	21.3333	68.0851
Potassium	95.4545	167.0454	27840.9090	101547.3800
Calcium	37.0857	44.0000	9114.2857	49299.9170

These may cause severe metal poisoning in years to come when the metallic content in water will also become very high and kill off all life.

The Baltic lake (Sea), although deep, is undergoing eutrophication and stagnation, due to excessive nutrient inputs. Similarly lake Erie, Washington and Mandots (USA) are also slowly going dead due to high pollution inputs (McCaull & Crossland 1974). A similar condition has been found in lake Kariba in Africa (Begg 1970).

High eutrophication and pollution can be reversed by reducing/removing/controlling PO_4-P inflow (chiefly detergents as in lake Nainital). But as in lake Erie (McCaull & Corssland 1974), in lake Nainital also (Das 1978), Phosphate has been built up in the lake sediment over decades; and thus from this store of phosphate sufficient nutrient can be released even if future pollution inputs are stopped.

The mass fish mortality sequence in lake Nainital can be summed up as follows :—
Autumn Anacystis bloom ——→ Winter death of most plankton ————→ high DOM and SOM ——→ Depletion of Oxygen in December-January (Winter) ——→ evolution of Ammonia, H_2S & Methane ————→ FISH KILL.

Silt particles form nuclei for accumulation of organic matter (DOM, and SOM) around them. These have been observed to clog the gills of fishes as revealed by microscopical examination and cause asphyxiation. Besides, the decaying *Anacystis* blooms may also produce toxins which are harmful to fish life (Saxena *et al.* 1972, Doudoroff & Katz 1953, Hart and Fuller 1974).

The maximum mortality was of *Puntius ticto, P. sophore, P. conchonius,* as well of juveniles of *Cyprinus carpio* and *Schizothorax richardsoni.* Surprisingly, no juveniles of *Tor tor,* and *T. putitora* were collected during winter fish kill, although about 1000 dead fishes were collected and identified, nor were the adults seen. It, therefore, appears that mahseer (*Tor* spp.) is now extinct from lake Nainital, whereas 25-30 pounders were available even 20 years ago.

It appears that the toxicity of Ammonia and its compounds, as also of H_2S, is strictly correlated with the permeability of the gills (Jones 1962). According to Lagler (1964) a BOD above 3 mg/l, NH_4-N above 0.5 mg/l and DO less than 5 mg/l are fatal to fish. Our average values of BOD 15.6 mg/l, DO 1.40 mg/l and NH_4-N 0.84 mg/l during winter, offers a combination of pollutants in which no fish can live. Our results for lake Nainital conform to the conclusions of Hart (1948), Wallen (1951), Lagler (1964), Arnold (1969), Cairns (1972) and Frost & Collinson (1977) for polluted lakes of Western countries.

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CHELONIANS OF BANGLADESH AND THEIR CONSERVATION[1]

Mohammad Ali Reza Khan[2]

(*With two plates*)

Bangladesh supports 18 species of freshwater, two land tortoises and five marine turtles. Two of these are endemic when three other species are included in the Red Data Book of IUCN. Most species are threatened in the country mainly because of uncontrolled and round the year exploitation for commercial purposes.

INTRODUCTION

Bangladesh is potentially a rich chelonian country of the Indian sub-continent. Altogether 31 species or so of freshwater and marine turtles, and land tortoises are likely to be present in the sub-continent (Pritchard 1979 and Whitaker, pers. comm.). Of these, about 25 species are expected to be present in the present jurisdiction of Bangladesh, 20° 34′ to 26° 37′ N and 88° 45′ to 92° 40′ E., including 10 endangered species listed in Schedule I of Convention on International Trade in Endangered Species of Wild Fauna and Flora, Washington 1973 (CITES). Along with others all 10 endangered species are exported in large quantities and also consumed locally. There is no ban on the chelonian trade in Bangladesh. The statistics of the export promotion bureau (Anonymous 1981) revealed that there is a steady increase in the volume of export from Taka 1,000.00 (Tk. 15.00 is equivalent to 1 US Dollar) to Taka 12,948,000.00, between 1974-75 and 1979-80 fiscal years. The average export price is between 0.75 and 1.00 US dollar per kilo of live turtle. Marine turtle has no export value. This means about 1,000,000 kg. of freshwater turtles have been exported out of Bangladesh in 1979-80. The figure is expected to be much higher in 1981. According to local dealers and exporters about an equal amount or more is consumed by the local residents. Potential live turtle buyers are Hong Kong, Singapore, Thailand and Japan. Olivier (1979) mentions, "...it is openly admitted by officials (of Bangladesh) that the legal, documented trade in turtles represents the "tip of an iceberg", with large quantities being smuggled out illegally, principally to India, where they are re-exported". Thus the export figure represent less than one third of the total turtle trade.

Kachuga tecta, Kachuga tentoria, Lissemys punctata, Trionyx hurum and *Trionyx gangeticus* are the main species that dominate the export trade although all freshwater turtles may actually be in the export list. These species and the land tortoises are consumed through local markets while the eggs of all the species of marine turtles are eaten by the tribals.

So far three scientific reports have appeared on the turtles and tortoises of Bangladesh and erstwhile East Pakistan after the publication of Fauna of British India by Smith (1931). These are Ahamed (1955), Shafi & Quddus

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(1977) and Husain (1979). The last two papers are in Bengali. Ahamed (1955) listed nine species of freshwater turtles whereas Shafi & Quddus (1977) reported 11 species including the nine of the preceding author and another five species of marine turtles. Husain (1979) added one unidentified species of *Geochelone* (*Testudo*) to Shafi & Quddus and provided some information on the status. Although Shafi & Quddus (1977) claimed that their report is based on the collection of specimens, this is difficult to substantiate as there appears to be a few specimens in the collection of the Dacca University Zoology Museum (DUZM). Inclusion of *Chrysemys picta* seems to be an erroneous one as it is purely a New World species, according to Pritchard (1979). *Emyda granosa* is possibly not a valid species and it is considered to be a subspecies of *Lissemys punctata.* Also addition of *Chelonia emys* and [3]*Chelonia amboinensis* under marine turtles can not be justified as no current literature includes such names in this group (vide Pope 1964, Pritchard 1979 etc.) Hence the total number of turtles and tortoises listed from here by all previous workers of the country stands to only 13 that is, 10 freshwater, one land and two marine. But according to my own field and literature survey there are about 25 species of chelonians in Bangladesh including two endemic species — *Trionyx nigricans* and *Morenia petersi* as stated below.

Family EMYDIDAE

1. **Hardella thurji** Gray. Brahminy River Turtle/Kali Kaitta[4]

Hardella thurji occurs in all major rivers of Bangladesh, from Padma in the west to Kushiyara in the east, and in their tributaries. Along with all the other species of freshwater turtles this species is sold in the markets of Dacca, Savar, Narayanganj, Narsinghdi, Daudkandi, Chandpur, Chittagong, Mymensingh, Phulchari ghat, Bagerhat, Chalna port, Barisal Sri Mongal and Sunamganj. Actually these are the main turtle markets of the country. Kali kaitta is common nowhere in Bangladesh and there is only one specimen in DUZM. The maximum catch is between October and March and it is occasionally exported.

2. **Batagur baska** Gray. Common Batagur

Batagur baska is largely an estuarine species. It has never been reported from Bangladesh although IUCN Red Data Book on turtles (Groombridge, in press) included Bangladesh within its range while Olivier (1979) and Gittins (1980) doubted its presence in Bangladesh. Recently a large specimen has been brought to Dacca Zoological Garden from the estuarine river, bordering the Sunderbans Mangrove Forest. It was caught by the fishermen from the river Mongla — a tributary of the largest estuarine river Passur that cuts across the Sunderbans before discharging into the Bay of Bengal. This is the first authentic report of the occurrence of *B. baska* in Bangladesh based on actual specimen.

It breeds along the mouths of the rivers Katka and Konga within Sarankhola Range of the Sunderbans (Whitaker 1982, pers. comm.).

3. **Kachuga tecta tecta** Gray. Roofed Turtle/ Kori Kaitta

K. t. tecta is the commonest and the smallest of the chelonians of Bangladesh. It is found all over the country, barring the hilly areas of the east, and the distribution is rather uniform over the entire range. I have seen them both in running and stagnant waters including pools and puddles in the villages. They often cross the crop fields, when the pools get dried up during winter, with a view to reaching a new pool. It is caught in large numbers and is relished by the local hindus and christians. They buy them in hundreds and keep them in empty kerosine oil tins and use them whenever needed. DUZM specimens (other than that of Shafi & Quddus 1977) do not exceed 12 cm, carapace length. It is included in Schedule I of CITES.

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[3] Once the authors have used 'Chelonia' and again 'Chelone', possibly synonymously.

[4] Bengali name. All hard-shell freshwater species are called *kaitta;* soft-shell ones *kasim* and land tortoises as *kossop.*

4. **Kachuga tentoria** Gray. Roofed Turtle/ Majhari Kaitta

Kachuga tentoria has received its specific status in the recent past. Formerly it used to be considered as a subspecies of *Kachuga tecta* (Pritchard 1979). May be for the same reason it has never been included in the list of Bangladesh turtles. Both these species were found in the same pond at Faridpur (Fig. 1). It is as common as the preceding one and has a similar distribution in the country, that is, it occurs sympatrically with the former. DUZM has a dozen of them.

5. **Kachuga smithi** Gray. Roofed Turtle/ Vaittal Kaitta

Kachuga smithi is a poorly known species of Roof Turtle from Bangladesh. According to Smith (1931), Annandale collected several specimens of this species from Rajshahi. Shafi & Quddus (1977) has given no account of its distribution within the country or abundance. It is occasionally found along the river Padma and its tributaries, and marshy areas (Chalan beel) attached to these within Rajshahi, Pabna and Kushtia districts. I did not see any basking aggregations of it in the Padma. Pritchard's (1979) statement that 'this is a common species in Bangladesh south of Jhelum' appears to be erroneous as Jhelum is a river of the Indus system in Pakistan. Moreover the species is not common in Bangladesh.

6. **Kachuga dhongoka** Gray

Smith (1931) has given its distribution as 'N. E. India; the Ganges as far west as Allahabad and north to Nepal. Anderson states that it has been found in the Brahmaputra in Assam'. Recently (1981) a shell has been collected from the suburbs of Dacca.

7. **Kachuga kachuga** Gray

It is occasionally found in the Padma, near Rajshahi and is also sold in the market, which needs confirmation as I failed to procure one when I visited the markets.

8. **Kachuga sylhetensis** Jerdon

Kachuga sylhetensis is likely to be present in Khasia and Jaintia of Sylhet and Garo hill areas of Jamalpur and Mymensingh districts bordering the Khasia and Garo Hill Ranges of India.

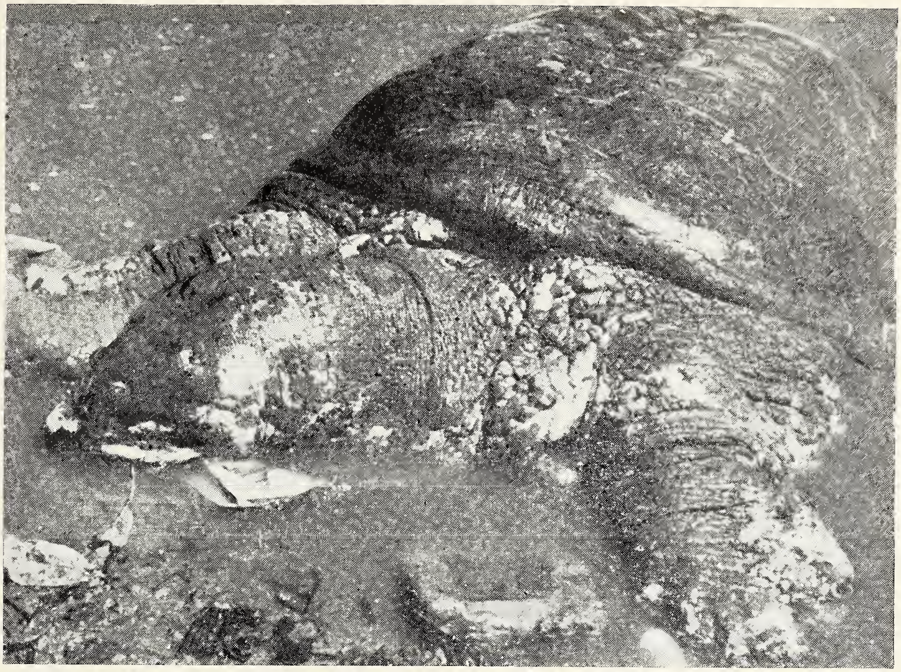
9. **Melanochelys tricarinata** Blyth. Threekeeled Terrapin

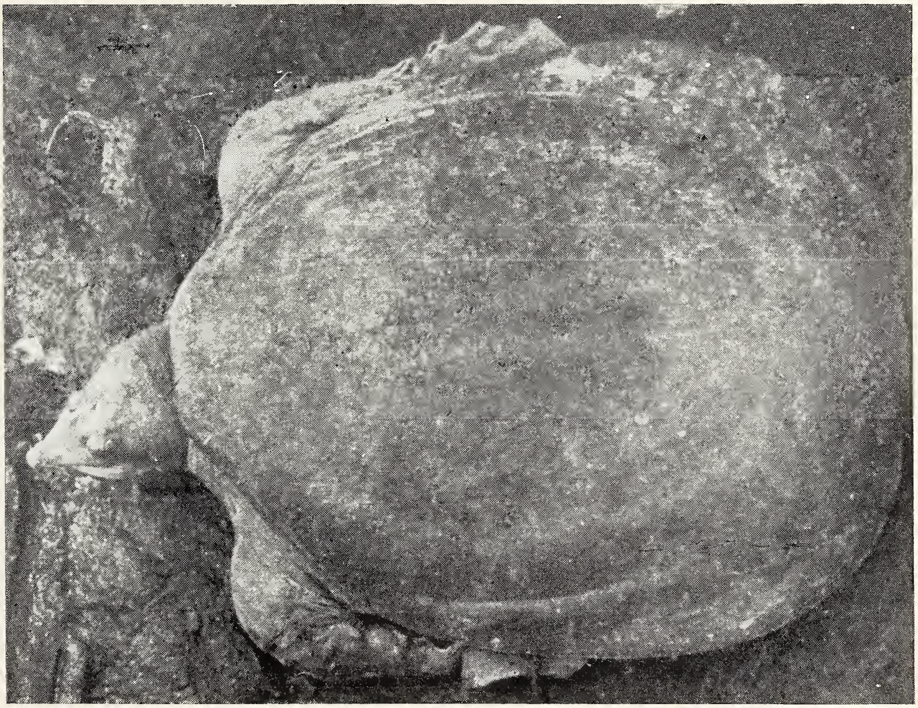
M. tricarinata is possibly present in the extreme north-west corner of Bangladesh that is in Tentulia and Panchagarh areas of Dinajpur district as has been suggested by Pritchard (1979). One specimen has been collected from Mymensingh district. About the occurrence of *Melanochelys trijuga indopeninsularis* Annandale, Pritchard (1979) said, it is found in Chota Nagpur and Jalpaiguri District of northern Bangladesh. Although the 'Jalpaiguri District' is within the Indian state of West Bengal parts of Sylhet, Mymensingh, Jamalpur, Rangpur and Dinajpur may be prospective areas in Bangladesh for its occurrence.

M. tricarinata is in Schedule I of CITES

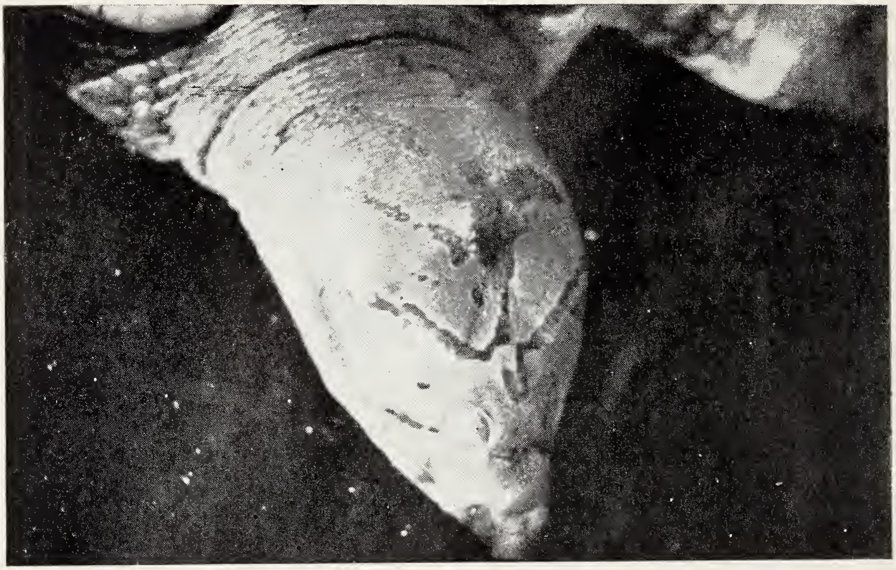
10. **Curora amboinensis** Daudin. Malayan Box Turtle/Diba Kasim

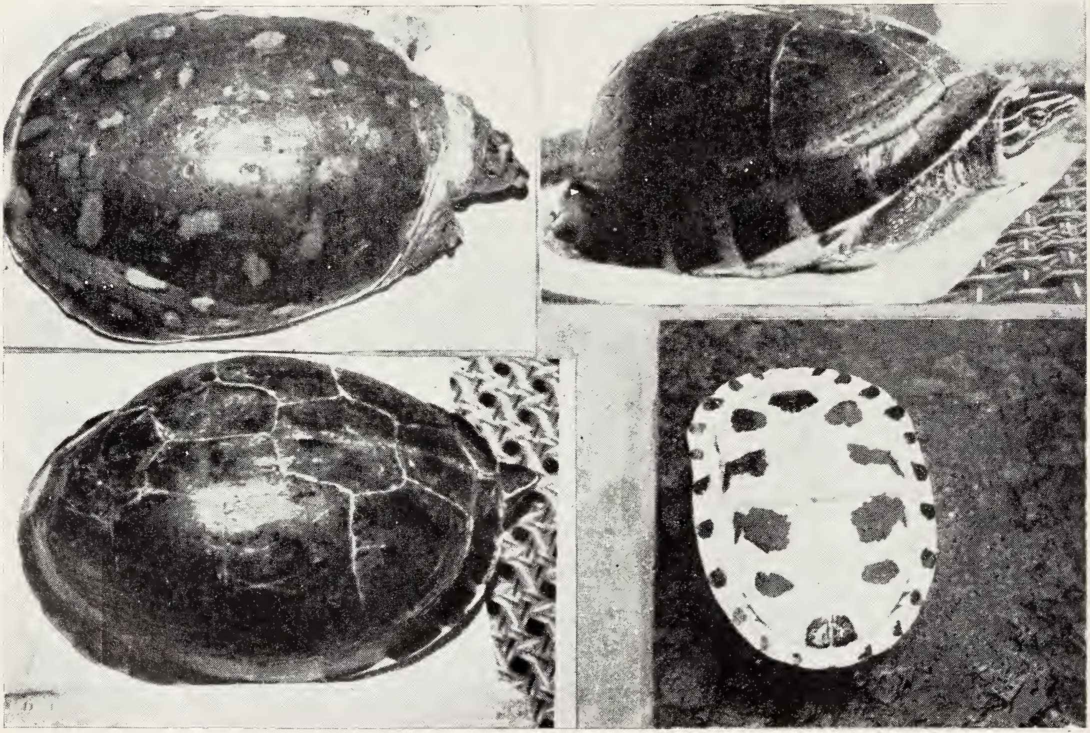
C. amboinensis has not yet been reported from any part of Indian sub-continent. Its





Above: *Trionyx nigricans* from Bostani tank at Chittagong.
Below: *Trionyx hunum* from foot of Garo hills.





Above: Head of a *Trionyx gangeticus*.
Middle: (Left)—*Lyssemys p. punctata* from Cox's Bazar;
(Right)—Side view of *Curora amboinesis*.
Below: (Left)—The 3rd central (Vertebral) is a divided one *C. amboinensis*.
(Right)—Ventral side of a *C. amboinensis*.

distribution has been given as "Tenasserim, Thailand, Cambodia, Vietnam, Malaysia, Indonesia...Philippines" by Pritchard (1979), who has actually adopted this distribution from Smith (1931). Recently I have collected a live specimen from Cox's Bazar area of south-eastern Bangladesh from the neighbourhood of a semi-evergreen forest. The turtle was crossing a highway that cuts across the denuded forest which is now planted with Malayan Oil Palm. Groombridge's (pers. comm.) conjecture that it might have been transported from Malayasia along the oil palm seems unlikely.

11. **Morenia petersi** Anderson. Yellow Turtle/ Haldey Kaitta

Although Smith (1931) and Pritchard (1979) restricted the distribution of *M. petersi* to Jessore, Dacca and Fategarh (?) within Bangladesh, to me it is a common turtle seen basking in Padma and Jamuna river systems of Bangladesh. It basks in rows on the newly accreted sandbars or on sand slabs along the eroded bank of these rivers. They drop down to water at the slightest disturbance or approach of a boat, fisherman or bather but stick their heads out of water again in no time, a few paces away from the intruder. It is caught in good number and is eaten too.

12. **Geoclemys hamiltoni** Gray. Black Pond Turtle/Mogom or Kalo Kaitta

G. hamiltoni is usually found in old fairly large tanks, perennial marshes, etc. and although distributed over the entire country, minus the hilly areas, cannot be considered a common species. It is eaten by the local people. The species has been included in Schedule I of CITES.

Family Testudinidae

13. **Geochelone emys** Schlegel & Muller, Brown Burmese Tortoise/Pahari Kossop

Husain (1979) was the first to report of its occurrence in Bangladesh although he did not mention the species name. I had the occasion to check the empty shell of this species with him which turned out to be *G. emys*. This species is found only in the forested belt of the Chittagong Hill Tracts district of Bangladesh. During my several visits to these forests I did not come across one. But the tribal *chakmas* told me that occasionally they collect it. It has a very high market value and specially so during the *biju* festival of the *chakmas*. Sometimes they use the empty shell of *G. emys* for washing clothes or for making door-step for their thatched houses.

14. **Geochelone elongata** Blyth. Hill-Tortoise/ Pahari Haldey Kossop

Unlike the preceding species *G. elongata* is not rare in the forested areas of Chittagong Hill Tracts. On three occasions I have recorded them from the *chakmas*, who were taking them home from the reserved forest area. Olivier's (1979) report of its export from Bangladesh is questionable as it is never gathered and sold in bulk in any market both inside and outside the hilly areas, and local exporters failed to confirm his report. Therefore this is the first confirmed report of its occurrence in Bangladesh.

Family Trionychidae

15. **Lissemys punctata punctata** Bonnaterre. Spotted Flap-Shell/Sundhi or Tila Kasim

One of the commonest of the soft-shells *L. p. punctata* is found all over Bangladesh, mostly in stagnant water specially in village ponds and marshy areas. It is sold in all turtle markets and is exported out too. The species has been listed under Schedule I of CITES.

16. **Trionyx gangeticus** Cuvier. Ganges Soft-

Shell/Khalua or Gonga Kasim

T. gangeticus is common in all major rivers of Bangladesh. Found in good number in ox-bow lakes and larger bodies of water. It is one of the species that is sold in the market round the year, has the highest market value and is exported.

17. **Trionyx hurum** Gray. Peacock Soft-Shell/ Dhum Kasim

Like the preceding species it is very common round the year, and found in all rivers excepting the hill ones and has good market value during monsoon when catches of other species is low. It has good export market too. Both *T. gangeticus* and *T. hurum* are sold at a flat rate of one US dollar, during monsoon, per kilo of freshly cut turtle. The butchers cut them live through the hinder part of the frontal pair of callosities, when the poor turtle bleed profusely right in front of the buyers.

18. **Trionyx nigricans** Anderson. Bostami Turtle/Bostami Kasim

T. nigricans is an endemic species found only in small pond, attached to the shrine of Hazrat Byazid Bostami, at the outskirt of Chittagong town (Khan 1980). All three reports from Bangladesh (vide Ahamed 1955, Shafi & Quddus 1977, and Husain 1979) did not include this species in their list inspite of the fact that Smith (1931) quoting Annandale gave a quite comprehensive account of the species. I have already mentioned that all large specimens in the pond has some sort of fungal infection on their skins of neck and limbs. These turtles, numbering about 200, are almost entirely dependent on the food supplied to them by the shrine visitors. It mostly comprised of beef offal, prawns, plantain and puffed rice.

All the abovementioned three species of *Trionyx* are included under Schedule I of CITES. Although the Bostami Turtle enjoys highest protection the remaining two are mercilessly exploited for commercial purposes.

19. **Chitra indica** Gray. Asiatic Soft-Shell Turtle/Sim or Chitra Kasim

C. indica is the largest of all turtles of Bangladesh and found over entire Padma and Jamuna river systems and in their tributaries. A great number of them are sold in the market and exported during winter, between October-February, and sometimes up to May-June, before the break-out of heavy monsoon. Although Pritchard (1979) suggested that 'it prefers clear water' all rivers of Bangladesh become quite turbid during monsoon and all will have crystal clear water before winter which will last up to next monsoon.

20. **Pelochelys bibroni** Owen. Bibron's Soft-Shell/Jata Kasim

Although Smith (1931) altogether doubted its presence in Bengal, Pope (1964) and Pritchard (1979) did not even include Indian sub-continent within its range, whereas Shafi & Quddus (1977) and Husain (1979) have categorically included *Pelochelys bibroni* in their lists. It is said to have wide distribution and is marketed too.

Family CHELONIIDAE

21. **Chelonia mydas** Linnaeus. Green Turtle
22. **Caretta caretta** Linnaeus. Loggerhead Turtle
23. **Lepidochelys olivacea** Eschscholtz. Olive Ridley Turtle
24. **Eretmochelys imbricata** Linnaeus. Hawksbill Turtle

Family DERMOCHELYIDAE

25. **Dermochelys coriacea** Linnaeus. Leatherback Turtle

All the five species of marine turtles, from no. 21 to 25, are locally called Samudrik Kasim. They are usually found along the coast of Bay of Bengal, from the Sunderbans in the West to the St. Martin Island in the extreme south-east. The eggs of Green, Ridley, Hawksbill, and Leatherback turtles are usually collected and eaten by fishermen, specially the tribal *moghs* and low-caste hindus. The Green Turtle is the commonest of the Marine Turtle found in Bangladesh.

Conservation Measures

The Government has promulgated Bangladesh Wildlife (Preservation) Order 1973 which under Schedule III bans hunting, killing capturing and exporting of all wild animals excepting those mentioned in Schedule I and II. Although these two schedules do not include turtles and tortoises the turtle trade seems to be absolutely uncontrolled and literally there is no implementation of the Ordinance so far as turtles are concerned. This is mainly because turtles are handled by the Ministry of Fisheries and Livestock who are mostly concerned with commercial exploitation rather than protection of animals, which is done by Ministry of Forests.

Uncontrolled and ill-planned exploitation of all the species of freshwater and land chelonians, and egg-collection, for the sake of trade alone might lead to the extinction of several species from Bangladesh. Therefore immediate steps are necessary to bring the turtle under the management of the Forest Department as they have some personnel for protection. The entire turtle trade must be handled carefully and judiciously.

A general survey of the status and distribution of the chelonians must be done immediately with a view to assessing the export and home consumption potential. Export of all species of freshwater turtles mentioned in the Schedule I of CITES be banned and quota to be fixed for the annual export for the species not covered by CITES.

Acknowledgements

I am thankful to Mr. Romulus Whitaker, Director, Madras Snake Park, India and Mr. Tsutomu Hikida, Kyoto University, Japan, who allowed me and provided facilities to accompany them in their survey of the *Varanus* species of Bangladesh during June-July, 1981, when I picked up *Curora amboinensis* from Cox's Bazar. I thank Prof. Kazi Zaker Husain, Dept. of Zoology and Dr. Mahmud-ul Ameen, Professor and Chairman, Dept. of Zoology, University of Dacca, for permitting me to check the specimens of turtles lying with and DUZM, and those of Shafi and Quddus kept in the reference cabinet. Thanks are also due to Prof. Edward O. Moll, Chairman, Freshwater Chelonian Specialist Group; Mr. J. C. Daniel, Curator, Bombay Natural History Society, and Dr. Brian Groombridge, Compiler, RDB-Amphibia/Reptilia, for making enquiries regarding Bangladesh chelonians which has literally forced me to take a fresh look at the subject.

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NEW PLANTS FROM URBAN ENVIRONMENT OF BARODA, GUJARAT[1]

S. N. PATIL AND S. D. SABNIS[2]

(*With a plate*)

INTRODUCTION

The urban centre of Baroda has of late been experiencing phenomenal growth of population and human settlements due to rapid industrialization. These sudden developments have created problems affecting the physical environment and the biotic components as well. The effects of these intense biotic stresses on the quality and quantity of the vegetal cover at Baroda are presently being assessed. While working with this ecological problem, a number of plants hitherto not reported either from Baroda or from the wider region of Gujarat (Shah 1980) have been noted. The present note, therefore includes our observations on the morphology, phenology and availability of these plants in the urban areas of Baroda.

Amaranthus dubius Mart. Hort. Erl. 197, 1814; Fl. Males. 4 (1): 79, 1954.

An erect, much-branched annual herb with striate stem. Leaves ovate, cuneate at the base. Flowers in axillary and terminal spikes; bracts ovate with a long mucro, thinly membranous; tepals 5, with a thin midrib in lower half, much thickened in the upper half; stamens 5; styles 3.

Rare, the plant was noted along the banks of a nallah near the sewage disposal area.

Flowers & Fruits: July-October.

SNP. 536.

Andrachne telephioides Linn. Sp. Pl. 1014, 1753; Hooker 5:284; Tackholm 245. (Plate).

A prostrate, glabrous herb. Stems many, 6 to 20 cms. long, arising from the root stock, slender, leafy. Leaves sessile, obovate, fleshy with tapering base. Male flowers smaller, clustered in axils, and females solitary and double in size; disc glands slightly lobed, membranous; style 3 fid. Capsule depressed globose, hairy.

The plant was collected from the moist banks of Timbi tank.

Flowers & Fruits: December-March.

SNP. 721, 1036, 1037.

Conyza leucantha (D. Don) Ludlow and Raven, Kew Bull. 17 71, 1963.

C. viscidula Wall. ex DC., Prodr. 5: 383, 1836; Hooker, 3: 258; Duthie 1: 410.

A tall, glandular-pubescent corymbosely branched herb. Leaves lanceolate, narrowed at both ends, viscid-puberulous on both surfaces. Heads yellow, in large, loose corymbs. Achenes obovoid, margined, first minutely hairy then glabrous.

The plant was collected in wheat fields from Makarpura and Maneja area.

Flowers & Fruits: December-February.

SNP. 742, 1086.

Cyperus pulcherrimus Willd. in Kunth, Enum. v. 2 (1837) p. 35; Hooker 6: 600; Cooke 3: 376.

A tufted stout herb. Stem trigonous. Leaves

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[1] Accepted May 1980.

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narrowly linear, 1-nerved. Umbel compound, contracted with many rays; bracts 3-6. Spikelets densely crowded; Rachilla not winged; glumes ovate-oblong, obtuse, with crisped incurved tips, sides hyaline with 2 reddish brown bands; stamens 2. Nut half as long as glume, stipitate, trigonous, acute at both ends, granulate.

The plant was collected from shady localities on moist banks of Vishwamitri river.

Flowers & Fruits: January-April.

SNP. 768, 1074, 1075.

Eriocaulon cinereum R. Br. Prodr. 254, 1810.

E. sieboldianum Sieb. & Zucc. ex Steud. Syn. Pl. Cyp. 2: 272, 1855; Hooker 6: 577; Cooke 3: 357.

A stemless, glabrous herb. Leaves linear-oblong. Peduncles glabrous, many-ribbed; heads white-puberulous; receptacles, involucral and floral bracts glabrous.

Not common; observed on the muddy banks of Harni and Timbi ponds.

Flowers & Fruits: September-December.

SNP. 687, 996.

Euphorbia zornioides Boiss. in DC. Prodr. 15(2) 19, 1862; Hooker 5: 246; Cooke 3: 60.

A glabrous erect herb with reddish stem. Leaves linear-oblong with pink margins. Involucres solitary, glabrous; petaloid limbs rosy with ovate lobes. Capsule globose.

Noted in cultivated fields mixed with grasses at Pratapnagar area.

Flowers & Fruits: July-September.

SNP. 92, 330.

Hemigraphis crenata (Bth. ex Hohenack.) Bremek. in Mat. Mon. Strob. 137, 1944.

H. elegans Nees var. *crenata* (Bth. ex Hohenack.) Clarke, in Hk. f. FBI. 4: 425, 1844; Cooke 2: 435.

A partly diffuse, viscid herb, softly white hairy. Younger stem subquadrangular, hairy. Leaves ovate, crenate-serrate, not sharply toothed, base cuneate, hairy. Flowers in heads; sepals subequal, one much larger than other four, linear hairy, and ciliate. Corolla tube pale blue, limbs blue, ovate; stamens 4, two longer densely bearded in their upper half by long, flat papilose hairs. Capsule linear-oblong, pubescent; seeds 8-10, orbicular.

The plant was collected from moist banks of Vishwamitri river.

Flowers & Fruits: January-April.

SNP. 540, 745, 1079.

Shah (op. cit.) reports this species on the authority of Saxton and Sedgwick (1918, p. 289) who collected it from North Gujarat.

Hydrocotyle javanica Thunb. Dissert. Hydroc. p. 3, No. 17, p. 6, t. 2, 1798; Hooker 2: 667; Cooke 1 : 597. (Plate).

A long, succulent prostrate and decumbent herb. Leaves sub-orbicular, sub-entire, coarsely crenate, hairy on nerves. Flowers pale green, crowded in dense, globular umbels. Fruit orbicular, mericarps with acute primary ridges.

The plant was collected from the moist banks of Harni tank under the shade.

Flowers & Fruits: October-January.

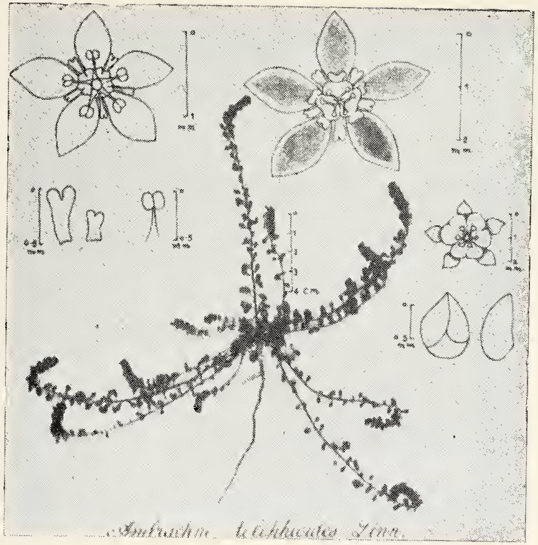
SNP. 694, 1030.

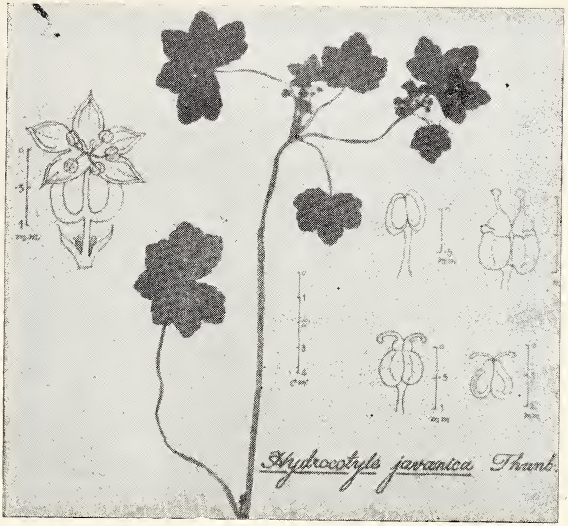
Cooke in Flora of Bombay Presidency has included this plant on Woodrow's authority. He has seen no Bombay specimen and none from that of the Presidency in Herb. Kew.

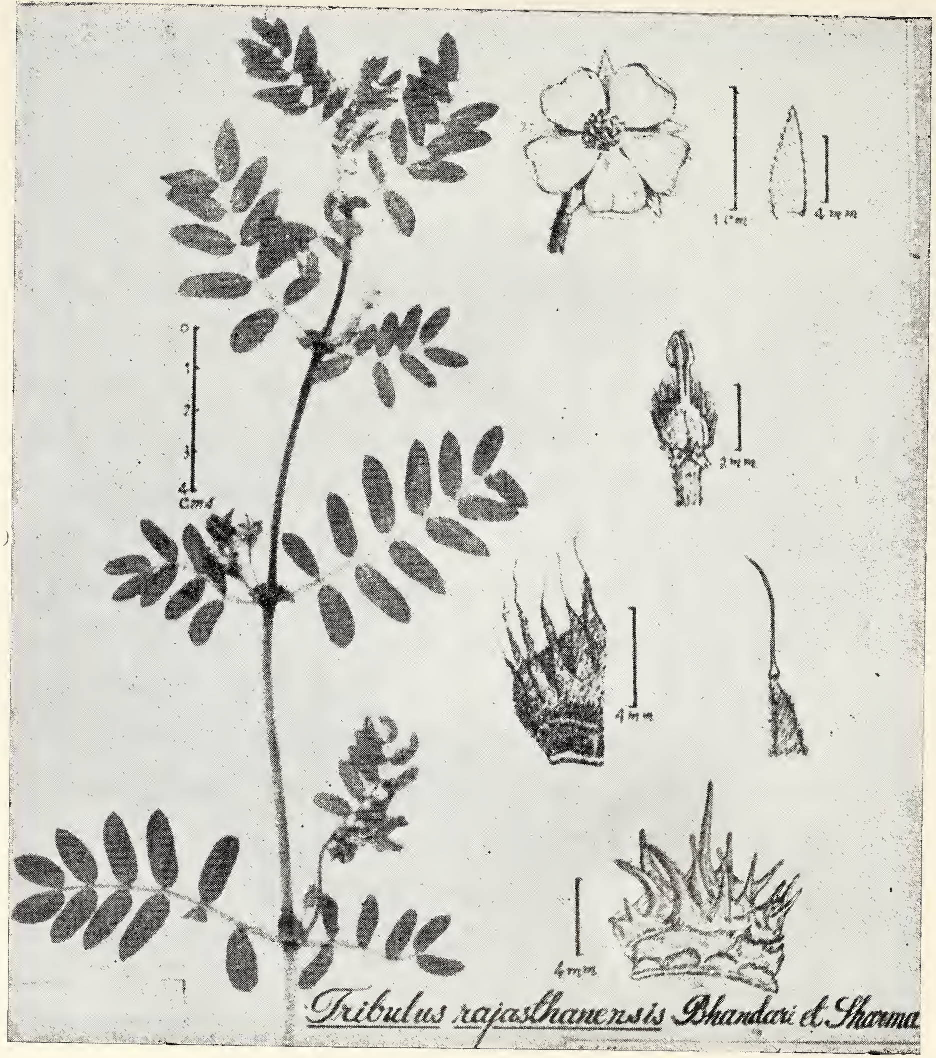
According to Santapau [Fl. Saurashtra (1963), p. 254] *Hydrocotyle* is occasionally, though rarely found in Western India.

Tribulus rajasthanensis Bhandari et Sharma in Bot. Notiser, 129: 367, 1976; Bhandari, Fl. Ind. Desert 88, 1978. (Plate).

A diffusely prostrate herb. Stem densely pubescent and sparingly hirsute. Leaves opposite, alternate in lower region, unequal at nodes; leaflets upto 7 pairs. Flowers bright yellow; stamens 8; ovary with bulbous-based, bristly hairs directed upwards; stigma pyra-


Andrachne telephioides Linn.
4 cm
mm


Hydrocotyle javanica Thunb.
cm
mm


Tribulus rajasthanensis Bhandari et Sharma
0
1
2
3
4
Cms
1 cm
4 mm
2 mm
4 mm
4 mm

midal. Fruit with 5 cocci, with 2 main spines and many smaller, unequal spines, densely hirsute.

It is easily separated from *T. terrestris* Linn. by much more densely hirsute cocci and absence of a pair of secondary spines; instead much more pronounced and stouter spines are present.

It was collected from Cotton fields at Atladara.

Flowers & Fruits: September-November.

SNP. 623, 624.

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OBSERVATIONS ON FOOD HABITS OF SIX SPECIES OF INDIAN FROGS[1]

P. MOHANTY-HEJMADI AND B. K. ACHARYA[2]

The analysis of the stomach contents of six species of frogs *Rana breviceps, Rana cyanophlyctis, Rana limnocharis, Microhyla ornata, Uperodon systoma* and *Rhacophorus maculatus* were done during July and August 1978. This investigation showed partial selectivity in feeding which probably is based on the ecological niche each occupies and thus provided an insight into the interactions amongst members of the six species.

INTRODUCTION

A good deal of literature is available on the food habits of anurans to demonstrate that they are some of the major predators of pests in nature. Several comprehensive papers such as that of Clarke (1974) on the genus *Bufo*, and Blackith and Speight (1974) on the genus *Rana* are available. However, most of the information is based on work on temperate species. Relatively little information is available on the species from tropical regions, especially that from India. Out of the 111 species of anurans in India (Daniel 1963), only the food habits of *Rana tigerina* (See literature review by Issac and Rege 1975) and **Bufo** *melanostictus* (Behura *et al.* 1971, and Rangaswamy and Channabasavanna, 1973) are known. In the course of the study of Biology of anurans from Orissa (Mohanty-Hejmadi 1977), the food habits of six species, *Rana breviceps, Rana cyanophlyctis, Rana limnocharis, Microhyla ornata, Uperodon systoma* and *Rhacophorus maculatus*, were studied.

MATERIALS AND METHODS

Study site: All the frogs were collected from an area of one square kilometer radius around the Vani Vihar campus of Utkal University, Bhubaneswar. Vani Vihar is located 25 metres above sea level at 20° 17′ 55″N latitude and 85° 50′ 12″ E longitude. The climate of Bhubaneswar and the surrounding area is of tropical monsoon type with dry evergreen forest, vegetation of wide variety, Shrub forests, cultivable land, ponds and ditches which are filled with floating or submerged vegetation. Collection data for the 6 species of frogs from different localities, taken during or immediately after rainfall are as follows. The data obtained is for one season in the year.

Rana breviceps : These frogs were collected from three different localities only during the breeding season. The first batch was collected from a rocky area near Orissa State Housing Board near Utkal University campus at night on 22nd July, 1978. The second and third batches were collected from the bank of two semipermanent pools inside Utkal University campus at night on 23rd July, 1978.

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Rana cyanophlyctis: They were captured from three different localities. Two batches were collected at night from two semipermanent pools inside Utkal University campus on 21. VII. 1978. The third batch was collected in the morning from a temporary pool near Orissa State Housing Board on 3rd August.

Rana limnocharis: Two batches were captured at night from the bank of two semi-permanent pools located about 100 metres apart inside Utkal University campus on 11. VII. 78 and on 12. VII. 78.

Microhyla ornata: The frogs were collected from two different localities during July, 1978. The first batch was collected at night from a scrub area near P. G. Department of Botany, Utkal University on 12.VII.78. The second batch was also collected the same night from a scrub area near Orissa State Housing Board.

Uperodon systoma: Three batches of these burrowing frogs were captured at night from three different localities. The first batch was collected from a temporary pool located inside Regional Research Laboratory, adjacent to Utkal University Campus. The second and third batches were collected from two temporary pools located inside Utkal University Campus on 23.VII.78.

Rhacophorus maculatus: Two batches were collected at night from the bank of a semi-permanent pool on 12.VII.78 and again on 13.VII.78. The last batch was collected at night from a rocky area on 15.VII.78. All these areas are located inside Utkal University Campus.

All six species of frogs were captured by hand or net depending on their habits. The frogs were dissected within 4 hr. after collection. The volume of the stomach contents were measured by water displacement. The stomach contents were analysed, identified and classified, as far as possible and preserved in 4% formalin. The number and percentage of each kind of prey item was summarized for each species of frog.

RESULTS

Rana breviceps (Schneider): A number of items were found but two food items made up a major portion of the diet (Table 1). These were adult winged termites (Isoptera) and beetles (Coleoptera). Other items were members of Hymenoptera, Dictyoptera, Orthoptera and spiders (Arachnid). In some of the stomachs pebbles and vegetation were also recovered. Thirty-two per cent of stomachs were found empty. The size range of food items varied from 2 (Coleoptera) to 12 mm (winged termite).

Rana cyanophlyctis (Schneider): Stomach content analysis revealed that their major food item was earthworm (Annelida). The second most important item was Coleoptera followed by Isoptera. Other food items consisted of members of Hymenoptera, Orthoptera, insect eggs and even tadpoles. In some of the stomachs vegetation was also recovered. Earthworms occurred as a major food item in all the three batches of these frogs (Table 1). The size range in length of food items was from 3 mm (ant) to 90 mm (earthworm).

Rana limnocharis (Weigmann): Insects belonging to Coleoptera followed by Hymenoptera were the most common food item for them. Other prey items included samples from unidentified Hymenoptera, insect appendages, arthropod larva, spider and an unidentified invertebrate. Besides these, in some of the stomachs pebbles and vegetation were also recovered.

Microhyla ornata (Dum-bib): Insects belonging to Hymenoptera, especially to family

TABLE 1

FOOD OF SIX SPECIES OF FROGS, *Rana breviceps, Rana cyanophlyctis, Rana limnocharis, Microhyla ornata, Uperodon systoma* AND *Rhacophorus maculatus* FROM BHUBANESWAR, ORISSA.

	Rana breviceps		*Rana cyanophlyctis*		*Rana limnocharis*		*Microhyla ornata*		*Uperodon systoma*		*Rhacophorus maculatus*	
No.	25		25		25		25		25		25	
Body length (range) in mm	31-44		27-65		21-44		18-25		53-79		43-78	
Body Mean volume in cc	35.92		42.12		32.60		21.08		64.92		47.40	
Mean stomach volume in cc	0.56		0.52		0.48		0.10		1.78		0.22	
	Prey items		Prey items		Prey items		Prey items		Prey items		Prey items	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Isoptera (Termitidae)	90	71.2	9	13.28	1	1.92	5	4.09	360	91.32	2	28.56
Coleoptera	16	12.8	18	24.28	20	40.51	9	6.70	16	4.34	1	14.28
Hymenoptera (Formicidae)	4	3.2	2	3.34	5	13.46	106	86.57	14	3.04	1	14.28
Hymenoptera (Vespidae)	2	1.6	1	0.94	—	—	1	0.87	—	—	—	—
Unidentified Hymenoptera	—	—	—	—	1	1.92	—	—	—	—	—	—
Orthoptera (Acrididae)	1	0.8	—	—	—	—	—	—	—	—	1	14.28
Orthoptera (Gryllidae)	—	—	2	2.82	—	—	—	—	—	—	—	—
Dictyoptera	1	0.8	—	—	—	—	—	—	—	—	1	14.28
Insect appendages	—	—	—	—	15	28.85	—	—	—	—	—	—
Arthropod larvae	—	—	—	—	1	1.92	—	—	—	—	—	—
Arachnidae (Spiders)	2	1.6	—	—	1	1.93	—	—	—	—	—	—
Annelida (Earthworms)	—	—	26	37.14	—	—	—	—	—	—	—	—
Unidentified Invertebrates	—	—	—	—	1	1.93	—	—	—	—	—	—
Tadpole	—	—	1.0	1.42	—	—	—	—	—	—	—	—
Pebbles	4	4.4	—	—	4	7.68	2	1.87	6	1.29	—	—
Vegetation	5	3.6	12	17.08	2	3.84	—	—	2	0.43	1	14.28
Empty stomach	8	32	4	16	10	40	9	36	10	40	16	64
Length of food item in mm.	2-12		3-90		3-11		3-3.4		3-11		3-17	

Formicidae were the most important food of these frogs. Other food items included samples from Termitidae (non winged forms), Coleoptera and Vespidae (Hymenoptera). In some of the stomachs pebbles were also observed (Table 1).

Uperodon systoma (Schneider): A number of items were found, but there were as many as 360 termites (winged forms) in 7 stomachs, indicating that termites (Isoptera) were the favourite food of *Uperodon systoma* (Table 1). Other food items included examples from Coleoptera and Hymenoptera (Formicidae). Some of the stomachs contained pebbles and vegetation.

Rhacophorus maculatus (Gray): The food items of this frog include samples from termitidae (Isoptera), Coleoptera, Hymenoptera, Orthoptera and Dictyoptera. Most of the stomachs (64%) were empty indicating that it is an opportunistic feeder. The number of food items were also less. But the most common food of this species were the insects belonging to Isoptera, which ranked first. In some of the stomachs vegetation was also recovered. The length range of food item was from 3 mm (ant) to 17 mm (Orthoptera).

DISCUSSION

According to the size of frogs, *M. ornata* is the smallest and consumed food items within the narrow range of 3.0 to 3.4 mm. *Rana limnocharis* which is next in size, had a larger range in size of food items (3.4 to 11 mm), but, concentrated mostly on smaller sized Coleoptera (3-4 mm). *Rana breviceps,* a burrowing frog came next in size which consumed food items in the range of 2 to 12 mm however, concentrating mostly on larger sized termites. *Rana cyanophlyctis* is the only aquatic of the six species. Therefore, it consumed aquatic insects and annelids. The range of food item was from 3 mm to 9 cm (earthworm). Being given to considerable movement at night it also had consumed other terrestrial insects. Earlier Mohanty-Hejmadi *et al.* (1979) have reported that this frog being both diurnal and nocturnal feeds both during day and night but the intake is higher at night.

Rhacophorus maculatus, the most mobile of the six which can sometimes be found on the 3rd floor of the buildings, did not seem to concentrate on any particular food item. A high percentage of the stomach were empty indicating that it is a highly opportunistic feeder perhaps feeding on insects that happen to be available. Although the range of food items was from 3 to 17 mm, the frog concentrated mostly on larger items. Mohanty-Hejmadi *et al.* (1979) have reported that this frog, being totally nocturnal, feeds at night.

Uperodon systoma, the spade foot frog of India, was the largest of the two burrowing frogs. The percentage of termites in their food items would indicate that it is selective for termites. One frog had eaten as many as 150 termites. The range of food item was from 3 to 11 mm concentrating mostly on 10-11 mm winged termites. It is interesting to note that these frogs are found in numbers near termitaries and the emergence of this frog coincides with the emergence of termites following heavy rains (Mohanty-Hejmadi, unpublished). Whitaker *et al.* (1977), have shown that termites were one of the most important food items for *Scaphiopus couchii,* in all three samples. They also reported that much of the bulk of food of *Scaphiopus* were large items. That burrowing frog populations usually inhabit concentrated food areas have been discussed by Emerson (1976). Our findings agree with her view. The concentration on winged termites and lack of mud supports the view that *Uperodon* mainly feeds at the surface rather than underground. Mohanty-Hejmadi *et al.* (1979) have reported that the feeding schedule is perhaps restricted to the breeding season in this animal.

If one takes by habitat niche each frog occupies, the two burrowing ones, *R. breviceps* and *U. systoma* compete with each other as they concentrate on larger termites.

The small frogs which live under debris and stones near ponds like *M. ornata* and *R. limnocharis* consume smaller food items. However, *M. ornata* seems to concentrate on ants while *R. limnocharis* concentrates more on smaller beetles. This would indicate a partial niche separation in their feeding habits. The aquatic *R. cyanophlyctis* seemed to consume items not readily available to other frogs. However, it is a competitor of the other carnivorous aquatic fauna such as fishes. Since *R. cyanophlyctis* can move with equal facility on land, it also consumes other insects and thus its food niche overlaps to some extent that of other anurans. *R. maculatus* being a terrestrial frog, ventures into niches not accessible to other frogs. This is reflected in its lack of food preference. The high number of empty stomach reflects that it eats less frequently than the other frogs examined. When it eats it prefers larger prey, the number being less. In contrast, *U. systoma* concentrates both on number as well as larger size. A close examination of the food habits indicate that Smith's (1950) comment on the food of *Scaphiopus bombifrons* that "large enough to be seen and small enough to be swallowed" seems to be an appropriate description of the prey the frogs choose. Availability probably is the next parameter for the food items as the habitat each of the frog was reflected in each of the frogs food habits.

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A CATALOGUE OF APHIDIID (HYMENOPTERA: APHIDIIDAE) PARASITES OF APHIDS (HOMOPTERA) OF INDIA[1]

A. K. Ghosh[2]
and
Basant K. Agarwala[3]

Introduction

Aphids are known to be preyed upon or parasitized by a number of insect groups including Coleoptera, Diptera, Neuroptera, Heteroptera and Hymenoptera. Amongst the parasitoid Hymenoptera the members of the family Aphidiidae form the major group of primary parasites of aphids. Mackauer (1968) has listed 331 species in his world catalogue of Aphidiidae of which only 7 species were recorded from India. Stary (1970) has given an extensive account of the biology of aphidiid parasites with respect to aphid control including a list of known genera of Aphidiidae of the world.

The first published information on aphidiid parasites in India could be traced back to 1912 when Viereck described a new species of the group from south India. Subsequently a number of stray records have been published mostly from north, north-eastern as also from south India. But no comprehensive account of the group from India has been published till date.

In the present catalogue 46 species and 12 other undetermined species or species complex, belonging to 14 genera out of 30 genera known from the world and three subfamilies, have been listed along with their aphid hosts, aphid host-plants, period of incidence, distribution and references. A separate host parasite index added. The generic classification as given by Stary (1970) has been followed in the present work.

Subfamily: EPHEDRINAE

Genus *Ephedrus* Haliday 1833

E. campestris Stary
Host: *Macrosiphoniella sanborni* (Gill.) ex. *Chrysanthemum* (Oct.).
Dist.: Jammu & Kashmir.
Lit.: Shuja Uddin 1978.

E. lacertosus (Haliday)
Hosts: *Myzus persicae* (Sulzer) ex. indet. host, *Neomyzus circumflexus* (Buckt.) ex. *Convolvulus major* (Jan.); indet. aphid.
Dist.: Jammu & Kashmir, Himachal Pradesh, Meghalaya.
Lit.: Rao 1969, Subba Rao & Sharma 1960 b, Sharma & Subba Rao 1964.

E. niger Gautier, Bannamour & Gaumont
Hosts: *Macrosiphoniella sanborni* (Gill.) ex. *Chrysanthemum* (Nov.); *Uroleucon tanaceti indicus* A. K. Ghosh & Raychaudhuri ex. *Chrysanthemum* (Nov.).
Dist.: Jammu & Kashmir, Meghalaya.
Lit.: Rishi 1976, Stary & Ghosh 1975.

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E. persicae Froggatt
Host: Not mentioned.
Dist.: Jammu & Kashmir.
Lit.: Rishi 1976.

E. plagiator (Nees)
Hosts: *Acyrthosiphon pisum* (Harris) ex. *Pisum sativum* (Mar.); *Aphis citricola* v.d. Goot ex. *Bidens pilosa* (Dec.-Jan.), *Cyphomendra betaceae* (Dec.-Jan.), *Eupatorium riparium* (Feb.-Mar.), *Spiraea* (Mar.); *A. craccivora* Koch ex. unidentified; *Lantana camara, Psidium guajava* (Jan.-Apr.), *Spiraea* (May); *A. fabae solanella* Theobald ex. *Solanum nigrum; Brachycaudus helichrysi* (Kalt.) ex. *Gynura crepidiodes* (Dec.); *Capitophorus* sp. ex. *Polygonum; Macrosiphoniella sanborni* (Gill.) ex. *Chrysanthemum* (Apr.-May); *Macrosiphum pachysiphon* H. R. L. ex. *Rubus rosaefolius; M. rosae* (L.) ex. *Rosa canina* (May); *Macrosiphum* sp. ex. *Rosa; Myzus ornatus* Laing ex. *Duranta; M. persicae* (Sulzer) ex. *Antirrhinum majus* (Feb.), *Artemisia vulgaris* (Aug., Oct.), *Brassica* spp. (Jan.-Apr.), *Capsicum annuum* (Jan.-Apr.), *Chenopodium album* (May-Jul.), *Cyphomandra betacea* (Jan.-Apr.), *Eupatorium riparium* (Feb.), *Impatiens balsamina, Solanum tuberosum* (May-Jul.), *Lantana camara* (Oct.), *Pisum sativum* (Nov.), *Polygonum* (May-Jul.), *Prunus communis, Psidium guajava* (Nov.), *Rubus rosaefolius* (Aug.), *Solanum tuberosum, Sonchus arvensis, Sonchus corymbosa, Triticum* spp.
Dist.: Jammu & Kashmir, Uttar Pradesh, Northeast India, Karnataka.
Lit.: Rao 1969, Rishi 1976, Stary & Ghosh 1978, Raychaudhuri *et al.* 1978.

Ephedrus sp.
Hosts: *Aphis citricola* v.d. Goot. ex. *Spiraea* (Jul.); *A. ruborum longisetosus* Basu ex. *Rubus ellipticus* (Dec.); *Myzus dycei* Carver ex. a plant of Urticaceae (Dec.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1975.

Genus *Toxares* Haliday 1840

T. deltiger (Haliday)
Hosts: *Aphis citricola* v.d. Goot ex. *Hibiscus* (Apr.); *Brachycaudus helichrysi* (Kalt.) ex. *Prunus domestica* (Apr.), *Capitophorus hippophaes* Walker ex. *Polygonum chinensis* (Jan.); *Metopolophium euryae* (Takashshi) ex. *Eurya acuminata* (Feb.); *Myzus ornatus* Laing ex. Unidentified plant (Apr.); *Myzus persicae* (Sulzer) ex. *Dianthus* (Feb.), *Gynura crepidoides* (Jan.), *Solanum khasianum* (Apr.); *Schizaphis ortundiventris* (Signoret) ex. *Pyrus communis* (Apr.).
Dist.: Jammu & Kashmir, Meghalaya.
Lit.: Rishi 1976, Stary & Ghosh 1978.

T. macrosiphophagum Shuja Uddin
Host: *Macrosiphoniella sanborni* (Gill.) ex *Chrysanthemum* (Sep.).
Dist.: Jammu & Kashmir.
Lit.: Shuja Uddin 1974.

T. shigai Takada
Hosts: *Brachycaudus helichrysi* (Kalt.) ex. *Pyrus* (Apr.); unidentified host ex. *Triticum vulgare.*
Dist.: Jammu & Kashmir, Meghalaya, West Bengal.
Lit.: Dharmadhikari & Ramaseshiah 1970, Stary & Ghosh 1975, Rishi 1976.

T. zakai Shuja Uddin
Host: *Myzus persicae* (Sulzer) ex. *Solanum nigrum* (Sep.).
Dist.: Jammu & Kashmir.
Lit.: Shuja Uddin 1974.

Subfamily PRAINAE

Genus *Areoproan* Mackauer 1959

Areoproan sp.
Host.: Not mentioned.

Dist.: Jammu & Kashmir.
Lit.: Rishi 1976.

Genus *Proan* Haliday 1833

P. abjectum (Haliday)
Host: *Aphis craccivora* Koch ex. *Dolichos lablab* (Nov.).
Dist.: Karnataka.
Lit.: Dharmadhikari & Ramaseshiah 1970.

P. aff. **absinthii** Bignell
Hosts: *Aphis gossypii* Glover and *Dactynotus* sp. ex. *Artemisia vulgaris* (Jan.).
Dist.: Meghalaya.
Lit.: Dharmadhikari & Ramaseshiah 1970.

P. longicorne Marshall
Host: Indet. aphid (Jun.); elsewhere several species of *Acyrthosiphon, Dactynotus, Macrosiphoniella, Microlophium, Paczoskia* (Mackauer 1968).
Dist.: Jammu & Kashmir.
Lit.: Subba Rao & Sharma 1969 b.

P. myzophagum Mackauer
Hosts: *Acyrthosiphon pisum* (Harris) ex. *Pisum sativum; Aphis citricola* v. d. Goot ex. *Bidens pilosa; Macrosiphum* sp. ex. *Rosa; Myzus ornatus* Laing ex. *Duranta; M. persicae* (Sulzer) ex. *Argemone mexicana, Brassica oleracea* var. *capitata* (Oct.), *B. oleracea* (Jan.-May), *Nicotiana tabacum* (Jan.-May), *Polygonum perfoliatum, Polygonum* (Dec.), *Raphanus sativus* (Jan.-May), *Solanum tuberosum;* Indet. aphid ex. *Argemone mexicana, Artemisia vulgaris* (Jan.-May), *Duranta* and *Rosa* sp.
Dist.: Jammu & Kashmir, Himachal Pradesh, Assam, Meghalaya, West Bengal.
Lit.: Dharmadhikari & Ramaseshiah 1970, Rao 1969.

P. aff. **myzophagum** Mackauer
Host: *Aphis gossypii* Glover ex. *Lantana camara.*
Dist.: Meghalaya.
Lit.: Rao 1969.

P. necans Mackauer
Host: *Rhopalosiphum nymphae* (L.) ex. *Trapa bispinosa* (Mar.).
Dist.: Delhi.
Lit.: Subba Rao, Sarup & Sharma 1963, Mackauer 1968.

P. volucre (Haliday)
Host: Not mentioned; elsewhere a number of hosts all belonging to Aphidinae (Mackauer 1968).
Dist.: Jammu & Kashmir, Delhi.
Lit.: Subba Rao & Sharma 1960 b.

Proan sp.
Hosts: *Aphis craccivora* Koch ex. *Dolichos lablab* (Nov.); *Amphorophora*(?) sp. ex. *Rubus moluccanus, A. gossypii* Glover ex. *Eupatorium odoratum & Rubus moluccanus; Aphis* sp. ex. *Rubus moluccanus; Brachycaudus helichrysi* (Kalt.) ex. *Prunus domestica* (Apr.); *Dactynotus* (?) sp. ex. *Rubus moluccanus; Macrosiphoniella spinepes* Basu ex. *Artemisia* (Sep.); *Macrosiphum pachysiphon* H.R.L. ex. unidentified garden plant (Jun.); *M.* (*Sitobion*) *rosaeformis* Das ex. *Rosa* (Apr.); *Myzus ornatus* Laing ex. *Eupatorium odoratum; M. persicae* (Sulzer) ex. *Antirrhinum majus* (Feb.); *Myzus* sp. a plant of Rubiaceae (Jan.); *Rhopalosiphum nymphae* (L.) ex. *Rosa* (Apr.).
Dist.: Jammu & Kashmir, Meghalaya.
Lit.: Dharmadhikari & Ramaseshiah 1970, Stary & Ghosh 1975 and 1978, Rishi 1976.

Subfamily: APHIDIINAE
Tribe: APHIDINI
Subtribe: LYSIPHLEBINA
Genus: *Lysiphlebus* Foerster 1862.

L. ambiguus (Haliday)
Host: Not mentioned; elsewhere species of genera *Aphis, Brachycaudus, Hydaphis, Melanphis* and *Toxoptera* (Mackauer 1968).

Dist.: Jammu & Kashmir.
Lit.: Rishi 1976.

L. delhiensis (Subba Rao & Sharma)
Host: *Longiunguis sacchari* (Zehntner) ex. Sugarcane (Oct.-Nov.).
Dist.: New Delhi.
Lit.: Subba Rao & Sharma 1960 a.

L. testaceipes (Cresson)
Hosts: *Aphis craccivora* Koch ex. *Dolichos lablab* and *Glyricidia maculata* (Dec.-Mar.); *Longiunguis sacchari* (Zehntner) ex. Sugarcane (Nov.).
Dist.: New Delhi, Andhra Pradesh.
Lit.: Narayanan, Subba Rao & Sharma 1958, Ramaseshiah, Bhat & Dharmadhikari 1968.

Lysiphlebus sp.
Hosts: *Aphis craccivora* Koch ex. *Cajanus cajan; A. gossypii* Glover ex. *Hibiscus rosasinensis; Macrosiphum avenae?* and *Rhopalosiphum maidis* (Fitch) ex. *Triticum vulgare.*
Dist.: Jammu & Kashmir, Punjab, Assam.
Lit.: Rao 1969, Dharmadhikari & Ramaseshiah 1970.

L. mirazi Shuja Uddin
Host: *Longiunguis sacchari* (Zehntner) ex. *Saccharum officinarum* (Nov.).
Dist.: Uttar Pradesh.
Lit.: Shuja Uddin 1975.

Genus *Diaeretus* Foerster 1862

D. leucopterus (Haliday)
Host: *Eulachnus thunbergii* Wilson ex. *Pinus* (Feb.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1975.

Subtribe PROTAPHIDIINA
Genus *Pauesia* Quilis 1931

P. indica Stary
Host: *Lachnus tropicalis* (v. d. Goot) ex. unidentified plant (Jun.).
Dist.: Manipur.
Lit.: Stary & Raychaudhuri 1978.

P. laricis (Haliday)
Host: *Cinara (Cinarella) atrotibialis* David & Rajasingh ex. *Pinus* (Oct.-Nov.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1975.

Subtribe APHIDIINA
Genus *Aphidius* Nees 1818

A. nr. **avenae** (Haliday)
Host: Not mentioned.
Dist.: Jammu & Kashmir.
Lit.: Rishi 1976.

A. colemani Viereck
Host: *Aphis* sp. ex. on tobacco; *A. gossypii* Glover ex. *Vitis* (Jan.).
Dist.: Meghalaya, Karnataka, Southern India.
Lit.: Krishnamurti & Usman 1955, Stary & Ghosh 1978.

A. commodus Gahan
Host.: *Macrosiphoniella pseudoartemisae* (Shinji) ex. *Artemisia* (Apr.); *M. sanborni* (Gill.) ex. *Chrysanthemum* (Oct.).
Dist.: Uttar Pradesh, West Bengal.
Lit.: Dharmadhikari & Ramaseshiah 1970.

A. matricariae Haliday
Hosts: *Brachycaudus helichrysi* (Kalt.) ex. *Prunus* (Apr.); *Brevicoryne brassicae* (L.) ex. *Brassica* (Apr.); *Capitophorus hippophaes indicus* A. K. Ghosh ex. *Polygonum chinensis* (Jan.); *Lipaphis erysimi* (Kalt.) ex. *Brassica napus* (Jun.); *Myzus dycei* Carver and *M. persicae* (Sulzer) ex. unidentified plant (Dec.); *Myzus* sp. ex. a plant of Rubiaceae (Jan.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1975 and 1978.

A. rosae Haliday
Host: *Macrosiphum rosae* (L.) ex. *Rosa canina* and *Rosa* sp.

Dist.: Jammu & Kashmir, Sikkim, West Bengal.

Lit.: Rishi 1976, Raychaudhuri *et al.* (in press).

A. smithi Sharma & Subba Rao

Host: *Acyrthosiphon pisum* (Harris) ex. *Pisum sativum* (Feb.-Mar.).

Dist: Punjab, Delhi, Uttar Pradesh, West Bengal.

Lit.: Subba Rao & Sharma 1958, Rao 1969.

A. transcaspicus Telenga

Host.:*Rhopalosiphum maidis* (Fitch).

Dist.: Karnataka.

Lit.: *Kashiviswanathan* 1972.

A. uzbeckistanicus Luzhetzki

Host:*Macrosiphum* (*Sitobion*) sp. ex. *Triticum aestivum* and *Avena sativa* (Jan.-Apr.).

Lit.: Shuja Uddin 1975.

Aphidius sp.

Hosts: *Acyrthosiphon pisum* (Harris) ex. *Pisum sativum* (Feb-Mar.); *Aphis citricola* v. d. Goot ex. *Bidens bipinnata* and *B. biternatus* (Feb.), *Eupatorium odoratum* and *E. riparium* (Feb.), an unidentified plant (Jul.); *A. gossypii* Glover ex. *Abelmoschus esculentus* (Nov.-Apr.); *Artemisia vulgaris* (Apr.), *Cestrum nocturnum, Cyphomandra betacea* (Dec.-Mar.), *Duranta, Gossypium* (Nov.-Apr.), *Hibiscus rosasinensis* (Nov.-Apr.), *Lantana camara, Leucoceptrum annum, Malvaviscus conzonthie, Solanum melongena* (Nov.-Apr.); *A. fabae solanella* Theobald ex. unidentified plant; *Capitophorus* sp. ex. *Artemisia vulgaris* (Apr.); *Dactynotus* sonchi (L.) ex. *Lactuca* (Mar.); *Dactynotus* sp. ex. *Artemisia vulgaris; Macrosiphum* (*Sitobion*) *rosaeiformis* Das ex. *Rosa* sp. (Jun.-Nov.); *Myzus ornatus* Laing ex. *Duranta, Malvaviscus conzonthie; M. persicae* (Sulzer) ex. *Cyphomandra betacea* (Feb.), *Malvaviscus conzonthie; Schizaphis rotundiventris* (Signoret) ex. *Pyrus communis* (Apr.).

Dist.: Widely distributed all over India.

Lit.: Raju Rao 1954, Rao 1969, Stary & Ghosh 1975, Rishi 1976, Stary & Ghosh 1978.

Genus *Diaeretiella* Stary

D. rapae (M' Intosh)

Hosts: *Aphis gossypii* Glover ex. *Leucas aspera* (Jan.); *A. fabae solanella* Theobald ex. *Cestrum fasciculatum; Brevicoryne brassicae* (L.) ex. *Brassica* (Dec.-Apr.); *Hyalopterus atriplices* (L.) ex. *Chenopodium; Lipaphis erysimi* (Kalt.) ex. *Brassica* spp. (Dec.-Mar.); *Myzus persicae* (Sulzer) ex. *Cyphomandra betacea*; Indet. host. ex. *Euphorbia* sp.

Dist.: Jammu & Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, Assam, Meghalaya, West Bengal, Karnataka.

Lit.: Batra & Wadhi 1962, Kundu *et al.* 1965, Rao 1969, Stary & Ghosh 1975 and 1978.

Genus *Lysaphidus* Smith 1944

L. erysimi Stary

Host: Not mentioned; elsewhere *Brevicoryne erysimi* Holman and *Lipaphis erysimi* (Kalt.) (Mackauer 1968).

Dist.: Jammu & Kashmir.

Lit.: Rishi 1976.

L. qadrii Shuja Uddin

Host.: Indet. host ex. *Artocarpus heterophyllus* (Mar.).

Dist.: Uttar Pradesh.

Lit.: Shuja Uddin 1977.

Lysaphidus sp.

Hosts: *Aphis craccivora* Koch; *Macrosiphoniella sanborni* (Gill.) ex. *Chrysanthemum; Myzus persicae* (Sulzer) ex. *Cyphomandra betacea, Rhopalosiphum maidis* (Fitch) ex. *Sorghum*.

Dist.: Punjab, Uttar Pradesh, West Bengal.
Lit.: Rao 1969, Dharmadhikari & Ramaseshiah 1970.

Tribe TRIOXINI
Subtribe MONOCTININA
Genus *Monoctonus* Haliday 1833

Monoctonus sp.
Host.: Not mentioned.
Dist.: Jammu & Kashmir.
Lit.: Rishi 1976.

Subtribe TRIOXINA
Genus *Lipolexis* Foerster 1862

L. gracilis Foerster
Host: *Lipaphis erysimi* (Kalt.) ex. *Brassica campestris* (Jan.); Indet. aphid ex. *Cajanus cajan* (Mar.).
Dist.: Jammu & Kashmir, Delhi.
Lit.: Sharma & Subba Rao 1964, Rishi 1976.

L. scutellarus Mackauer
Hosts: *Aphis citricola* v. d. Goot ex. *Bidens pilosa, B. pinnata* (through out the year), *Dracocephalum* sp. (? *latifolium*), *Erechthites valarianaefolia, Eupatorium odoratum, Jacaranda mimosifolia, Melanthesa patens, Mikania cordata, Prunus amygdalus, Spiraea corymbosa; A. gossypii* Glover ex. *Cosmos* (Sep.), *Eupatorium* (Jul.), *Hibiscus rosasinensis* (Jun.-Sep.), *Lantana camara* (Dec.), *Psidium guajava* (Jul.); *A. nerii* B. d. Fonscolombe ex. *Calotropis gigantea* (Dec.-Jan.); *A. ruborum longisetosus* Basu ex. *Rubus ellipticus* (Jun.); *A. fabae solanella* Theobald ex. *Solanum; Aphis* sp., ex. *Cestrum nocturnum; Greenidea* (*Trichosiphum*) *formosana* ? ex. *Psidium guajava; Toxoptera aurantii* (B. d. Fonscolombe) ex. *Schima wallichii; T. citricidus* (Kirkaldy) ex. *Citrus* (Sep.), *Zanthoxylum* (Sep.); *Tuberolachnus salignus* (Gmelin) ex. *Salix* (Sep.).
Dist.: Jammu & Kashmir, Punjab, Uttar Pradesh, Assam, Meghalaya, West Bengal, Andhra Pradesh, Tamilnadu, Karnataka, Kerala.
Lit.: Rao 1969, Dharmadhikari & Ramaseshiah 1970, Stary & Ghosh 1975, Rishi 1976.

Genus *Trioxys* Haliday 1833
Subgenus *Betuloxys* Mackauer 1960

T. (B.) assamensis Stary
Host: *Betacallis querciphaga* Basu, Ghosh & Raychaudhuri ex. unidentified plant (Oct.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1975.

T. (B.) hortorum Stary
Host: Not mentioned.
Dist.: Jammu & Kashmir.
Lit.: Rishi 1976.

T. (B.) intermedius Shuja Uddin
Host: Indet. aphid ex. *Centaurea iberica* (Sep.).
Dist.: Jammu & Kashmir.
Lit.: Shuja Uddin 1975.

T. (B.) takecallis Stary
Host.: *Takecallis arundinariae* ex. unidentified Gramineae (Dec.).
Dist.: West Bengal.
Lit.: Stary & Raychaudhuri 1978.

Subgenus *Binodoxys* Mackauer

T. (B.) acalephae Marshall
Host.: *Aphis gossypii* Glover ex. *Cyanotis axillaris* (Jul.).
Dist.: Karnataka.
Lit.: Dharmadhikari & Ramaseshiah 1970.

T. (B.) basicuryus Shuja Uddin
Host: *Aphis gossypii* Glover ex. *Rubus* (May).
Dist.: Jammu & Kashmir.
Lit.: Sharma & Subba Rao 1964.

T. (B.) eutrichosiphini Stary
Host: *Eutrichosiphum* sp. ex. *Castanopsis*

(Sep.), *Litsea* (Oct.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1975.

T. (B.) indicus Subba Rao & Sharma
Hosts: *Aphis citricola* v. d. Goot ex. *Spiraea* (Jul.); *A. craccivora* Koch ex. a plant of Leguminosae (Sep.); *A. fabae solanella* Theobald ex. *Maesa* (Dec.); *A. gossypii* Glover ex. *Abelmoschus esculentus* (May-Jul.), *Bidens pilosa, Capsicum, Cestrum nocturnum, Chrysanthemum, Coccinea cordifolia, C. esculenta, C. indica, Colocasia* (May), *Cuscuta reflexa* (Sep.,), *Cymopsis tetagonaloba, Cyphomandra betacea, Dolichos lablab, Duranta, Eupatorium, Gossypium hirsutum* (Feb.), *Gossypium* sp., *Gynura crepidioides, Hibiscus rosasinensis* (Sep.-Oct., Dec.), *Lagenaria siceraria, L. vulgaris, Lantana camara, Portulaca, Psidium guajava* (May, Sep.), *Rumex dentatus, Solanum melongena* (Nov.-Mar.), *S. tuberosum, Tinospora, Trichosanthes anguina; A. nerii* B. d. Fonscolombe ex. *Calotropis procera* (Mar.), *A. ruborum longisetosus* Basu ex. *Rubus* (Dec.); *Brachycaudus helichrysi* (Kalt.) ex. *Gynura crepidioides* (Dec.); *Myzus persicae* (Sulzer) ex. *Cyphomandra betacea* and an unidentified plant (Nov.); *Sinomegoura citricola* (v. d. Goot) ex. *Ardisia* (Sep.); *Toxoptera aurantii* (B. d. Fonscolombe) ex. *Ilex* (Sep.); *T. citricidus* (Kirkaldy) ex. *Citrus* (Sep.), *Zanthoxylum* (July-Sep.).
Dist.: Jammu & Kashmir, Punjab, Delhi, Uttar Pradesh, Meghalaya, Manipur, West Bengal, Karnataka.
Lit.: Narayanan, Subba Rao & Sharma 1958, Subba Rao & Sharma 1958, Rao 1969, Shuja Uddin 1973, Stary & Ghosh 1975, Rishi 1976, Raychaudhuri *et al.* 1978, Stary & Ghosh 1978.

T. (B.) rubicola Shuja Uddin
Host: *Aphis gossypii* Glover ex. *Rubus* (May).
Dist.: Jammu & Kashmir.
Lit.: Shuja Uddin 1973.

T. (B.) shillongensis Stary
Host: *Sinomegoura pyri* Ghosh & Raychaudhuri ex. unidentified plant (Sep.).
Dist.: Meghalaya.
Lit.: Stary & Ghosh 1978.

T. (B.) sinensis Mackauer
Host: *Aphis craccivora* Koch and *A. gossypii* Glover ex. *Cestrum nocturnum* (Nov.-Dec.).
Dist.: Uttar Pradesh.
Lit.: Rao 1969.

Subgenus *Trioxys* Haliday 1833

T. (T.) auctus (Haliday)
Host: *Rhopalosiphum maidis* (Fitch) ex. *Sagittaria sagittifolia.*
Dist.: Assam.
Lit.: Dharmadhikari & Ramaseshiah 1970.

T. (T.) pallidus (Haliday)
Host: Not mentioned; elsewhere several species of Drepanosiphinae (Mackauer 1968).
Dist: Jammu & Kashmir.
Lit.: Rishi 1976.

Trioxys spp.
Hosts: *Macrosiphoniella spinipes* Basu ex. *Chrysanthemum* (Nov.); *Mollitrichosiphum tenuicorpus* (Okajima) ex. a plant of Fagaceae (Apr.); *Tuberculatus indicus* L. K. Ghosh ex. *Quercus griffithi* (Apr.).
Dist.: Jammu & Kashmir, Meghalaya.
Lit.: Stary & Ghosh 1975 and 1978, Rishi 1976.

ACKNOWLEDGEMENTS

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Myzus dycei :	*Aphidius matricariae* *Ephedrus* sp.
Myzus ornatus :	*Aphidius* sp. *Ephedrus plagiator* *Proan myzophagum* *Proan* sp. *Toxares deltiger*
Myzus persicae .. :	*Aphidius matricariae* *Aphidius* sp. *Diaeretiella rapae* *Ephedrus lacertosus* *Ephedrus plagiator* *Lysaphidus* sp. *Proan myzophagum* *Proan* sp. *Toxares deltiger* *Toxares zakai* *Trioxys* (*Binodoxys*) *brevicornis* *Trioxys* (*Binodoxys*) *indicus*
Neomyzus circumflexus :	*Ephedrus lacertosus*
Rhopalosiphum maidis :	*Aphidius transcaspicus* *Ephedrus plagiator* *Lysiphlebus* sp. *Trioxys* (*Trioxys*)? *auctus*
Rhopalosiphum nymphae :	*Proan necans* *Proan* sp.
Schizaphis rotundiventris :	*Aphidius* sp. *Toxares deltiger*
Sinomegoura citricola :	*Trioxys* (*Binodoxys*) *indicus*
Sinomegoura pyri :	*Trioxys* (*Binodoxys*) *shillongensis*
Takecallis arundinariae :	*Trioxys* (*Binodoxys*) *takecallis*
Toxoptera aurantii :	*Lipolexis scutellaris* *Trioxys* (*Binodoxys*) *indicus*
Toxoptera citricidus :	*Lipolexis scutellaris* *Trioxys* (*Binodoxys*) *indicus*
Tuberculatus indicus :	*Lipolexis scutellaris*
Tuberolachnus salignus :	*Trioxys* sp.
Uroleucon tanaceti indicus :	*Ephedrus niger*

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A CATALOGUE OF THE BIRDS IN THE COLLECTION OF THE BOMBAY NATURAL HISTORY SOCIETY—24

PYCNONOTIDAE

HUMAYUN ABDULALI

[*Continued from Vol. 78* (2): 286]

This part covers 640 specimens of 58 species and subspecies up to No. 1151 in INDIAN HANDBOOK.

1111 **Spizixos canifrons canifrons** Blyth (Khasia Hills) Finchbilled Bulbul 1:400

6: 1 ♂ 2 ♀♀ 3 o? (1 *fledgling)

1 Dumpep, 1 *Shillong, Assam; 1 *Pan Thabet watershed* 6500′; 1 *Katuring, Mogok Road,* 1 *Mt. Victoria,* 7000′ *Pakokku Hill Tracts;* 1 *Pimpri Ban, N. Shan States, Burma.*

The single adult female from Shillong has the underparts slightly paler than in the others. The fledgling from the same area is like the adult but paler all over, with the black on the head replaced by an olive-green which is darker than on the back. The throat and upper breast are light brownish white, and the lower parts yellowish. If Bangs and Phillips's *ingrami* is to be accepted the bird from N. Shan State may be of this race.

Measurements on p 146.

1112 **Pycnonotus atriceps atriceps** (Temminck) (Java) Blackheaded Bulbul 1:423

4: 2 ♂♂ 2 ♀♀

2 Rewa Tea Estate, S. Sylhet, Assam; 1 *Changtha, W. of Arakan Yomas;* 1 *Htugy, Henzada dist; Burma.*

The tails are shorter than indicated in *Ind. Handbook* (6:70) ex. Stuart Baker's *Fauna.*

Measurements on p. 146.

1113 **Pycnonotus atriceps fuscoflavescens** (Hume) (Port Mouat and Mt. Harriet, Andamans) Andaman Blackheaded Bulbul 1:425

9: 6 ♂♂ 3 ♀♀

2 Bakultala, Middle Andamans; 1 Port Blair, 3 Wrightmyo, 1 Mannarghat, 1 Bambooflats, 1 Chirria Tapoo, South Andamans.

Of the six males, four have dark, almost black caps, and are marked as with enlarged gonads. The other two males and the females have a varying amount of duskiness on the crown, but none as dark as in the breeding males. This dark cap appears to be a sexual difference which has yet been overlooked. *Indian Handbook* (6:70) quotes the *Fauna* to the effect that the measurements are as in nominate *atriceps,* but the wings appear to be distinctly smaller and the bills larger.

Measurements on p. 146.

1114 **Pycnonotus priocephalus** (Jerdon) (Peria Pass, Malabar) Greyheaded Bulbul 1:425

11: 8 ♂♂ 2 ♀♀ 1 o?

1 Molem, 2 Canacona, Goa; 1 Karwar, 1 N. Kanara; 1 Antarsante, 1 Kallar (?) 1 Sakleshpur, Hassan, Mysore; 2 Palni Hills; 1 Balamore Estate, Ashambu Hills, Travancore.

♂ No. 2092 from Sakleshpur, Hassan dist., Mysore, lacks the grey on the head. The olive-green on the upperparts in different specimens shows some variation.

Measurements on p. 146.

1115 **Pycnonotus melanicterus flaviventris** (Tickell) (Dampara in Dholbhum) Blackcrested Yellow Bulbul 1:397

44: 24 ♂♂ 16 ♀♀ 4 o?

1 Bori, Hoshangabad; 2 Kameli, Bailadila, 1 Antagarh, 2 Darba, M.P.; 2 Kutri, Daspalla, 3 Koira (Bonai), 2 Badrama (Bamra), Orissa; 2 Anantgiri, 1 Upper Sileru, Vizagapatnam; 3 Dehra Dun; 1 Ranibagh, Kumaon, 2 Pilibhit Terai, U.P.; 1 Rangpo, Sikkim; 1 Ganglipokte, Bhutan; 1 Longview, Darjeeling, Bengal; 2 Goalpara, 2 Margherita, 1 Yagte; 1 Tezu, Lohit Valley, 1 Namchik, A.P.; 1 Gorakhpur, S. Slyhet; 2 N. Cachar; 1 Kohima, Naga Hills, Assam; 1 *Sailong, Chindwin;* 1 *s.e. of Maymyo;* 1 *Thayetmyo,* 1 *Kganklabajiu, Mogok Road;* 1 *Sagaw, Chaung, Sandoway;* 1 *Htugyi,* 1 *Kywizin, Henzada;* 1 *Bassein, N. Yomas, Burma.*

Measurements on p. 146.

1116 **Pycnonotus melanicterus gularis** (Gould) (Travancore) Rubythroated Yellow Bulbul 1:415

13: 4 ♂♂ 7 ♀♀ 2 o?

2 Molem, Goa; 1 Santgal, 1 Karwar, 1 N. Kanara; 1 Agumbe, Shimoga dist; 1 Sagar, Mysore; 1 Kattamalai, Charambadi, 2 Gudallur, Nilgiris; 1 Bamboo forest; Wynaad; 1 Merchiston Ponmudi, 1 Rajaipara, Panthalam Hills, Travancore.

Measurements on p. 146.

1117 **Pycnonotus melanicterus melanicterus** (Gmelin) (Ceylon) Blackcapped Yellow Bulbul 1 : 414

1 ♀ Kudava, Sinharaja, Ratnapura, Ceylon.

Measurements on p. 146.

1118 **Pycnonotus jocosus pyrrhotis** (Bonaparte) (Nepal) Kumaon Redwhiskered Bulbul

1 ♀ Pilibhit — Terai.

Measurements on p. 146.

1119 **Pycnonotus jocosus abuensis** (Whistler) (Mount Abu) Rajasthan Redwhiskered Bulbul

nil.

1120 **Pycnonotus jocosus fuscicaudatus** (Gould) (Nilgiri Hills) Southern Redwhiskered Bulbul

33: 23 ♂♂ 8 ♀♀ 2 o?

1 Kanheri, 1 Goregaon, 2 Trombay, 1 Andheri, Bombay; 1 Matheran; 1 Khandala; 1 Savantwadi; 1 Molem, Goa; 1 Castle Rock, N. Kanara; 1 Anandapuram, 1 Ulavi, 2 Murgimatta, Sagar, Mysore; 4 Bangalore; 1 Runnymede, 2 Longwood Shola, Kotagiri, Nilgiris, 1 Kodaikanal; 2 Billaj, Billigirirangan, Coimbatore; 1 Shembaganur; 2 Begur, Manantaddy, 1 Balamore, Ashambu Hills, Kerala; 3 Shevaroy Hills; 2* Kurumbapatti, Salem. *(missing).

There is some variation in the depth of colour of the upperparts. The birds from from around Bombay have been accepted as *fuscicaudatus* one of the characters of which is an unbroken band across the breast. Specimens from Kanheri and Matheran, have broken bands and field observations subsequent to commencement of this study, and confirmed by others indicate that they do have a broken band around Bombay. No specimens of *abuensis* are available but this form in addition to having a broken band, is presumably much paler, and all birds from as far north as the neighbourhood of Bombay are only tentatively left under *fuscicaudatus.*

Measurements on p. 147.

1121 **Pycnonotus jocosus emeria** (Linnaeus) (Benghala) Bengal Redwhiskered Bulbul 1 : 394 (part)

12: 6 ♂♂ 6 ♀♀

4 Anantgiri, Vizagapatnam; 3 Bailadila, 1 Kotamsar, Bastar, M.P.; 1 Keonjgarh, 1 Gonia, Daspalla, 1 Koira, Orissa; 1 Sanchi, 1000′, West Bhutan.

♂ 1973 from Anantgiri, has no white tip to the tail, though this is present in the others and is probably a juvenile (Hume, S. F. xi p. 181). The bird from West Bhutan was obtained at an elevation of only 1000′ and not being as dark as the others under *monticola* is left with this form.

Measurements on p. 147.

1121a. **Pycnonotus jocosus monticola** (McClelland) (Kassia Mountains, Assam) Assam Redwhiskered Bulbul 1:394 (part)

16: 9 ♂♂ (1* juv.) 2 ♀♀ 5 o?

1 Sevoke, Teesta Valley, Sikkim; 1* Dibrugarh, 2 Sadiya, 2 Dibang Valley, Mishmi Hills, Assam; 3 Rupachena, Cachar; 2 *Sailong, Chindwin,* 2 *Kabaing, Mogok Road,* 2 *Tawman,* 1 *Mankim, Upper Burma.*

Of the 3 birds from Rupachena, Cachar, two have complete collars with one of them having no white tips to the tail, while the third agrees with others in the present group.

Measurements on p. 147.

1122 **Pycnonotus jocosus whistleri** Deignan (Cinque I., Andaman Is.) Andaman Redwhiskered Bulbul

13: 7 ♂♂ 6 ♀♀

2 Wrightmyo, 2 Mannarghat, Andamans; 4 Camorta, 2 Trinkut, 3 Nancowry, Central Nicobars.

In some specimens from the Nicobars, (where it is said to have been introduced from the Andamans) the bills are noticeably heavier than in *emeria.*

Measurements on p. 147.

1123 **Pycnonotus leucogenys leucotis** (Gould) (Karachi, Sind) White-eared Bulbul 1 : 390

31: 12 ♂♂ 17 ♀♀ 2 o?

These birds can be separated into two groups, one pale and the other dark on the upperparts. The material however is insufficient to warrant the description of a new race, and I am only drawing attention to this fact, listing and measuring them separately.

(a) *pale birds* 15: 4 ♂♂ 10 ♀♀ 1 o?

1 *Charbar, Persian Gulf;* 1 4000′ Bhani (Greshog), 132 m. s.s.w. of Kalat, Baluchistan; 1 Garo Sind; 3 Hamavas Lake, Pali, Jodhpur; 1 Rudra Mata, 2* Kuar Bet, Kutch; 1 Kharaghoda, 2 Dabka, Baroda; 3 Cawnpore (cage birds).

* This is an exceptionally pale juvenile with bars on the tail and an example of heterochrosis. Some remarks on the specimens have been published (Salim Ali, *JBNHS* 57(3) p. 658). Excluding the 3 cage birds from Cawnpore (which are very old and faded), all have been obtained in a contiguous area separate from that of the dark birds. If the two groups are separable, these will remain *leucotis.*

(b) *dark birds* 16: 8 ♂♂ 7 ♀♀ 1 o?

3 Lahore, 2 Multan, Punjab; 1 Bhung, Bahawalpur; 5 Bharatpur; 2 Delhi; 2 Goregaon, Bombay; 1 Dharamtar Creek, Kolaba.

The birds from the Bombay area are presumably relatively recent arrivals (first noted 1932 *et seq*) and may represent escapes which have managed to settle and are extending their range. When recording the first bird (*JBNHS* 37 p. 221) I drew attention to a small patch of orange-coloured feathers at the base of the bill (which character was noted in subsequent specimens too). This is published with another letter (loc. cit.) thanking the Society for drawing attention to the fact that birds from Persia and Mesopotamia showed the same trait which is not now visible in any specimen.

In addition to the darker upperparts, most of them have their underparts greyish, a character lacking in all the pale birds. The female from Multan (No. 16254) has the undertail coverts tinged orange.

Measurements on p. 147.

1124 **Pycnonotus leucogenys humii** (Oates) (Jalalpur near Jhelum, Punjab) Hume's White-eared Bulbul 1 : 391

9: 4 ♂♂ 2 ♀♀ 3 o?

1 Chitral, N.W.F.P.; 1 Rawalpindi, 1 Choa, Sardai State, Salt Range, 1 Jhelum, 5 Campbellpur, Punjab.

Three Campbellpur specimens from the A.E. Jones Collection are marked "Series shows much variation" and include two which I have listed under nominate *leucogenys.*

Most observers in the north-west have referred to both *leucotis* and *leucogenys* as migratory and there really appears to be no reason why *humii* and *leucogenys* should not occupy the same area, one or the other (probably the latter) as a non-breeding migrant. Excluding the two specimens referred to above, there appears to be a fair amount of uniformity among those listed as *humii,* which is undoubtedly an intermediate, though distinct form. As there are at least two Jalalpurs in the Punjab, it would be better to describe the type locality in greater detail as was done by Oates.

The vent is sulphur yellow as in nominate *leucogenys* and not a paler yellow as in *leucotis*.

Measurements on p. 147.

1125 **Pycnonotus leucogenys leucogenys** (Gray) (Kashmir) White-cheeked Bulbul 1:389

32: 15 ♂♂ (1 juv.) 15 ♀♀ (1 juv.) 2 o?

2 Campbellpur, Punjab; 1 Kashmir Valley; 1 Keonthal, 1 Dharamsala, 11 Simla; 1 Mussoorie, 1 Tharati, Gharwal; 1 Sameti, 1 Almora, 1 Kongain Jamsar, 1 Kumaon; 1 Nagarkhot, 1 Kollapi 7000′ Nepal; 2 Sikkim; 1 Chazam, below Tashigong, Rongtong, E. Bhutan; 3 Longview, Darjeeling, 1 Majakhot, Ranikhet; 1 Martam, Rong Valley, Assam.

All have the head and crest brown and not black as the chin, throat, and upper breast. The shade of brown varies in individuals from the same place, some of the feathers of the crest having pale, almost white fringes. All have the head darker than the back except ♂ 22423 from Chazam, Rongtong, E. Bhutan, in which it is the same colour as the back, and the chin and throat are also not jet black. It does appear different but there is no evidence of additional specimens having been procured in this area and Salim Ali in BIRDS OF THE EASTERN HIMALAYAS (1977) p. 120 refers to Bhutan birds as of this race.

Measurements on p. 147.

Hybrid **pycnonotus cafer** x **leucogenys**

2: 1 ♂ 1 ♀

Rawalpindi 14 Jan. 1927 and 6 January 1930.

The white on the cheeks is replaced by grey, the breast is as in *cafer* and the rump slightly paler than the back. The under tail coverts are yellow in the female and mixed red and yellow in the male. This hybrid, presumably with varying colours, is sufficiently common to have acquired a local name *Neemchi* (half-breed) (IH 6 p. 86). It is curious that this should be in the same area where *leucotis* and *leucogenys* have met and established a recognisable subspecies *humii*. The hybrid form from Bannu, N. W. F. P. was named *magrathi* by Whitehead (1908, Bull. B.O.C. 21 p. 48). This matter is discussed at length by Sibbs & Short (1959) Ibis 101 pp. 177-182.

Measurements on p. 147.

EL **Pycnonotus leucogenys lapersonnei** mss.

4: 2 ♂♂ 2 ♀♀

Nasratavad, Seistan Delta (31° N, 61° 10′E)

All four obtained by Lapersonne in October 1926 have their labels marked *Molpastes leucogenys lapersonnei* in the hand-writing* of the late Col. Meinertzhagen but I cannot trace any published description, and this would appear to be only a manuscript name. They are closer to the pale form of *leucotis* (1123a above) both in size and colour than to *mesopotamiae,* and may be the form described as *farahensis* by Koelz from Kandahar. Or the difference from *leucotis* may be just due to Lapersonne's exceptionally good skinning!

Measurements on p. 147.

*identified by Dr. Salim Ali.

EL **Pycnonotus leucogenys mesopotamiae** Ticehurst (Basra, Lower Mesopotamia).

12: 6 ♂♂ 6 ♀♀

4 *Nahr Umar, Right Bank, Tigris,* 1 *Hilla,* 1 *Euph-*

rates, 1 *Qarradh,* 1 *Baghdad,* 1 *Basra, Mesopotamia;* 2 *Shiraz,* 1 *Shustar, South Persia.*

This bird is distinctly larger than the other races, though no trace of the yellow rim round the eye is now visible. The three from Persia have their bills shorter than the average.

Measurements on p. 147.

Pycnonotus cafer

This species has been divided into several races in India and further eastwards but though a fair number of specimens is available, there is much variation and it is not possible to be very sure about the identity of several specimens leaving no option but to separate many on geographical grounds.

There is no definite evidence of the species undertaking any appreciable migration.

1126 **Pycnonotus cafer intermedius** Blyth (Upper Provinces = Murree) Redvented Bulbul 1 : 389

13: 5 ♂♂ 5 ♀♀ 3 o?

1 Kohat, N.W.F.P.; 1 Campbellpur, 1 Taxila, 1 Rawalpindi; 1 Kolka, 1 Mubarakpur, nr. Ambala, Punjab; 1 Bula, 1 Keonthal, 4 Simla, 1 Naini Tal, U.P.

In addition to the brown ear coverts and the black of the head grading into the brown back, they can be distinguished from *humayuni* by their longer and more distinct crest feathers.

Measurements on p. 148.

1127 **Pycnonotus cafer humayuni** Deignan (Deesa) Gujerat Redvented Bulbul 1 : 385

16: 8 ♂♂ 8 ♀♀

1 Multan, 2 Lahore, W. Punjab; 2 Ambala; 2 Delhi; 2 Bulundshar, U.P.; 1 Hamavas Lake, Pali, Jodhpur; 1 Tapheshwar, Kutch; 1 Vaghjipur, Mehsana, 1 Dohad, Panch Mahals, 1 Dabka, Baroda, 1 Gir, Amreli, 1 Laochali, Surat Dangs.

♀ 1873 from Hamavas Lake, Pali district, Jodhpur is very pale followed by ♂ 2744 from Vaghjipur, Mehsana. The others show differences and some can barely be separated from individuals of the adjoining races. The two from Bulandshar have been included here but they were collected in 1903 and the paleness is possibly due to fading.

Both birds from Lahore have a sooty wash on the underparts, a character shared with a brown-eared female (*intermedius*) from Rawalpindi.

Measurements on p. 148.

1128 **Pycnonotus cafer cafer** (Linnaeus) (Pondicherry) Redvented Bulbul 1 : 385

28: 17 ♂♂ 11 ♀♀

2 Bharatpur, Rajputana; 1 Sarawaya, Gwalior; 1 Jalgaon, E. Khandesh; 1 Malegaon, Surat Dangs; 2 Jabalpur, M.P.; 1 Dahisar, 1 Thana, 2* Andheri, Bombay, 1 Khandala, 1 Poona; 1 Alibag, Kolaba; 1 Satara; 1 S. Konkan; 1 Gotagali, 1 Santgal, N. Kanara; 1 Thattakad, N. Travancore, 1 Travancore; 2 Malavalli, Sidhpur, Mysore; 1 4500′ Shevaroy Hills, 1 Kurumbapatti, Salem, 1 Palkonda Hills, 2 Sheshachalam Hills, S. Cudappah; 1 coll. J.P. Cook = S. India(?)

(*1 missing)

The two from Bharatpur are distinctly darker than others under *humayuni.* ♀ 16216 from Jabalpore has the central pair of tail feathers completely white. One bird from Laochali, Surat Dangs has been placed in the last group, while another (♂ 16260) is as dark as any other *cafer.* ♂ 1877 from Satara is pale but dates back to 1897.

Measurements on p. 148.

1129 **Pycnonotus cafer haemorrhousus** (Gmelin) (Ceylon) Ceylon Redvented Bulbul 1 : 383

nil.

1130 **Pycnonotus cafer wetmorei** Deignan (Anantagiri, Vizagapatnam) Orissa Redvented Bulbul.

12: 4 ♂♂ 8 ♀♀ (3* paratypes of *saturatus*)
1 Sonawani, Balaghat; 1 Lohatta R. F., 2 Bhanuprattapur, Kanker C.P.; 1* Jeypore Agency, 2 Sankrametta, Vizagapatnam, 1 Mahendragiri, 1 Daspalla, 1 Kutri Das, 1 Karkot (Bamra), 1 Koira (Bonai), Orissa.

This subspecies was separated from nominate *cafer* as darker and with less white on the abdomen. The two (♂ and ♀) from Sankrametta have almost no markings or white on the underparts but that from Jeypore Agency which was included in the series described as *saturatus* by Whistler and Kinnear is no different from nominate *cafer* from south and west. ♀ 1883 from Sonawani, Balaghat is very dark below but marked *pallidus* (*humayuni*) by Salim Ali.

Measurements on p. 148.

1131 **Pycnonotus cafer bengalensis** Blyth (Bengal) Bengal Redvented Bulbul 1 : 387

25: 17 ♂♂ 8 ♀♀
1 Ranibagh, 1 Guptakashi, Garhwal, 1 Majkhali, Ranibagh, 2 Pithorgarh, Almora, Kumaon; 1 Bonzini, 1 Nawacot, Nepal; 1 Baghowni, 1 Tirhut, Bihar; 1 Rinchingpong, 1 Rangpo, W. Sikkim, 1 Sevoke, 1 Singtam, Teesta Valley, Sikkim; 1 Darjeeling; 1 Samchi (West), 1 Shangong (Central), 1 Deothang, 2 Gomchu (East), 1 Khosela, Bhutan; 1 Maniktola, Calcutta, 1 Rupchena, Cachar; 2 Dibrugarh, 1 Sadiya, Assam.

The ear-coverts in birds from scattered places are light/dark brown.

Measurements on p. 148.

1132 **Pycnonotus cafer stanfordi** Deignan [Taro or Dalu (lat. 26° 20′N., long. 96° 10′E), Upper Chindwin District, Sagaing Div., Burma] Burmese Redvented Bulbul

6: 2 ♂♂ 1 ♀ 3 o?
1 *Kabaing — Mogok Road, Ruby Mines Dist.*, 3 *Upper Burma;* 1 *N. Shan States;* 1 *Maymyo.*

These are paler than *bengalensis* both above and below, and have a shorter crest.

Measurements on p. 148.

EL **Pycnonotus cafer melanchimus** Deignan (Rangoon Town, Pegu, Burma)

1 ♂ *Prome, Burma.*

Differs from *stanfordi* in having the feathers of the upperparts more narrowly edged with ashy. It is not unlike nominate *cafer* from peninsular India, but differs in having a larger patch of black on the underbreast, and hair-brown and not black ear-coverts.

Measurements on p. 148.

EL **Pycnonotus aurigaster klossi** (Gyldenstolpe) (Doi Khun Tan, northern Siam lat. 18° 30′N., long. 90° 20′E.)

1 ♂ *Ataran, Amherst, Burma.*

The cheeks are whitish, there is a small patch of brownish on the chin and the rest of the underparts are whitish with patches of light brown. The original label is marked *M. nigripilius.* Wing 95, bill 17.5, tail 85.

1133 **Pycnonotus striatus striatus** (Blyth) (Darjeeling) Striated Green Bulbul 1 : 379

10: 4 ♂♂ 6 ♀♀ (1 topotype)
1 Darjeeling, Bengal; 1 Rinchingpong, Sikkim; 2 Shamgong, 6500′ (Central), 4 Narphong 5000′ (East), 1 Batawe, Bhutan; 1 *Tiddim, Burma.*

See remarks under 1134.

Measurements on p. 148.

1134 **Pycnonotus striatus arctus** Ripley (Dreyi, Mishmi Hills) Mishmi Striated Green Bulbul 1 : 379

3 ♂♂ (2 topotypes)
2 Dreyi, Lohit Valley, Mishmi Hills, N. E. Assam; 1 Langham, Naga Hills.

The topotypes do not appear different from the nominate from further west and the two races have been arranged in accordance with the distribution in *Ind. Handbook* (6:94).

The two males from Tiddim, Burma, just south of Manipur, (No. 1864) and Langhana, Naga Hills (1866) should be of the nominate race and *arctus* respectively. They differ from all the others by their smaller size, wings 103(2), bills 16.6, 15.2, tails 94, 92 (*contra* combined averages of males and females of both forms 110, 17.2 and 98) and yellower underparts.

Measurements on p. 148.

1135 **Pycnonotus xantholaemus** (Jerdon) (Eastern Ghats west of Nellore) Yellowthroated Bulbul 1 : 415

4: 1 ♂ 3 o?

1 Jogimaradi, Chitaldroog, 2 Horseleykonda 13° 40′N, 78° 26′E (Mysore); 1 Sankaridrug, Salem, Madras.

The most recent (1940) specimen shows a slight grey tinge on the upper parts and more yellow on the head *contra* brownish in the others which go back to 1902 and 1908 (2).

Measurements on p. 149.

1136 **Pycnonotus penicillatus** Blyth (Ceylon) Yellow-eared Bulbul 1 : 426

2 o? Ceylon.

Measurements on p. 149.

1137 **Pycnonotus flavescens flavescens** Blyth (Arakan) Blyth's Bulbul 1 : 392

3: 1 ♂ 1 ♀ 1 o?

2 Laisang, N. Cachar; 1 *Minderi Yoma, Thayetmyo, Burma;* 1 no locality.

The male has the head distinctly darker than the back and appears to show streaks on the breast not visible in any others either of this or the next race.

Measurements on p. 149.

EL **Pycnonotus flavescens vividus** (Stuart Baker) Salween District and Mulayit Taung, Amherst, Tenasserim) Mulayit Bulbul 1 : 393

3 o? (1 juv.)

2 *N′ Kraung, Upper Burma,* 1 *Loi Hansep, N. States, Burma.*

One specimen from N′ Kraung shows yellow upto the throat, which is dirty grey. Both adults have distinct dark caps and differ from the nominate specimens only in having yellow and not white lores.

Measurements on p. 149.

1138 **Pycnonotus luteolus luteolus** (Lesson) (Bombay) Whitebrowed Bulbul 1 : 417

29: 15 ♂♂ (3 juv.) 12 ♀♀ 2 o?

1 Dabka, Baroda; 1 Goregaon, 1 Malad, 2 Bandra, 1 Raita, Kalyan, 1 Bombay; 1 Malwan, Ratnagiri; 1 Canacona, Goa; 1 Bolgutt, 1 N. Kanara; 1 Bangalore; 1 Aramboli, 1 Travancore; 1 Kurumbapatti, 1 Chitteri Range, Salem; 2 Mettapalayam, Madras; 1 Palkonda Hills, 1 Seshachalam Hills, 1 Nallamalai Hills; 2 Konta, Bastar, M.P.; 3 Barkul, Chilka Lake, 1 Tikarpura, Angul dist., 1 Champeshwar, Orissa; 1 ♂* no data.

There is some variation in the colour of the upperparts; some (juveniles?) showing more rufous than the others. The amount of duskiness on the upper breast also varies and appears more prominent in the birds from around Bombay, which also have heavier bills. In some specimens the head is slightly darker than the back.

* Sp. No. 2087 with no data found listed with the species, has an almost chestnut brown head much more prominent than in the others.

Indian Handbook (6, p. 99) refers to 3 or 4 filoplumes on the nape. This occurs in both sexes but is not visible in all the specimens.

Measurements on p. 149.

1139 **Pycnonotus luteolus insulae** Whistler & Kinnear (Ceylon) Ceylon Whitebrowed Bulbul

nil.

EL **Pycnonotus xanthorrhous xanthorrhous** Anderson [Kakhyen (Kachin) Hills, Burma] Anderson's Yellowvented Bulbul 1 : 411

1 o? *North Shan States.*

Wings 89 (85-93), bill 16.3 (about 15), tail 84 (about 95).

EL **Pycnonotus finlaysoni finlaysoni** Strickland (Malacca) Stripethroated Bulbul 1 : 412

1 ♂ *Ataran, Amherst, Burma.*

The specimen from east of the Sittang River is old, faded and in poor condition and cannot be separated from *davisoni* below by the colour of the forehead. It is however appreciably smaller.

Measurements on p. 149.

EL **Pycnonotus finlaysoni davisoni** (Hume) (12 m. north of Rangoon) Stripethroated Bulbul 1 : 413

6: 3 ♂♂ 3 ♀♀

1 *Upper Burma;* 1 *Sandoway;* 2 *Bassein;* 2 *Rangoon, Burma.*

See remarks under *P. f. finlaysoni.*

Measurements on p. 149.

EL **Pycnonotus barbatus xanthopygos** (Hemprich & Ehrenberg) (Arabia) Yellow-vented Bulbul

2 ♂♂ Muscat, Arabia.

Wing 97, 98, bill 17.8, 18.6, tail 85.

EL **Pycnonotus blanfordi blanfordi** Jerdon (Pegu) Blanford's Olive Bulbul 1 : 420

5: 1 ♂ 3 ♀♀ 1 o?

1 *Shwebo, Upper Burma,* 1 *Shurdaung,* 1 *Prome;* 1 *Luzon,* 1 *Ingabin, Henzada, Burma.*

Measurements on p. 149.

EL **Hypsipetes thompsoni** (Bingham) (Loi San Pa = Taung Palaung) (lat. 21° 46′N, long. 96° 55′ E, Southern Shan States) Bingham's Whiteheaded Bulbul 1 : 373

3 o?

1 *Taungyi, S. Shan States;* 1 3500′ *Dawna Range, Amherst District;* 1 no data.

Measurements on p. 149.

1140 **Criniger flaveolus flaveolus** (Gould) (Nepal) Whitethroated Bulbul 1 : 363

37: 18 ♂♂ 13 ♀♀ 6 ♀♀

In the absence of sufficient material and literature it is not possible to untangle a very confused position. Seven of the specimens from the Chindwin area are part of a series of 21 obtained by the Vernay-Hopwood Chindwin Expedition in 1935 and reported upon by Mayr (*Ibis* 1938 p. 291). He said that "in series they agreed with a series of typical *flaveolus* from N. Cachar, except that the crown, back and wings are more washed with olivaceous, and the underwing is more yellowish less buff". The single specimen from N. Cachar resembles the others from Indian limits and the olivaceous wash on the upperparts and a different yellow on the underparts does isolate the Chindwin birds—no difference is visible on the underwing. The labels are marked *ochraceus, burmanicus* and *gularis* by different workers indicating at least that they did not think they were the same as *flaveolus* from India.

Two birds from Gamon Chaung, Sandoway (♀ 1782) and Nyaunggyo, Prome (♀ 1783) have their underparts a paler yellow than in the others and the white of the throat descends a little lower down the breast. There is a little grey on the forehead more prominent than in the others, but *burmanicus* (Oates, Toungoo, n. of Pegu) should have the whole crown and crest grey, and this is not so. These are the only specimens which show a white supercilium which according to Stuart Baker (1:363) is always present!? I am for the moment listing them all in separate groups under nominate *flaveolus.*

(a) *flaveolus* 28: 14 ♂♂ 9 ♀♀ 5 o?

2 Berrick, Sikkim; 3 Darjeeling, Bengal; 2 Tama 4000′, 3 Deothang, 1 Mangdechum, E. Bhutan; 2 Cherrapunji, Khasi Hills, 1 S. Sylhet, 2 Roopachena, 1 N. Cachar Hills; 2 Margherita, 2 Sadiya, 1 Tezu, Lohit Valley; 1 Bipani, 1 Asipani, Dibang Valley, 1 Rotang, 1 Maya, 1 Abor country, Mishmi Hills, Assam; 1 *n. of Maymyo, Burma.*

There is appreciable variation in the extent of yellow in the bill, and ♀ No. 180 from

Maya has it all yellow. In addition to an almost complete brown band across the upper breast, this specimen also shows a yellow collar round the hind neck.

(b) 7: 3 ♂♂ 3 ♀♀ 1 o?

1 *Punsin*, 1 *Yora*, 2 *Hai Bun*, 2 *Tawman*, 1 *Dalu*, *Chindwin River*, *Burma*.

See remarks above.

(c) 2: 1 ♂ 1 ♀

1 *Nyaunggyo*, *Prome District*; 1 *Gamon Chaung*, *Sandoway*, *Burma*.

See remarks above.

Measurements on p. 150.

1141 **Hypsipetes viridescens cacharensis** (Deignan) (Chutla Bhil, Cachar District, Surma Valley & Hill Division, Assam) Olive Bulbul. 1 : 406

1 ♀ Rupachena, Cachar, Assam.

The single specimen is separated from the two nominate ones on the basis of the distribution in Deignan, 1948; Races of the Bulbul *Microscelis charlottae* (Finsch) and its Relatives (*Proc. Biol. Soc. Washington*, 1948, pp. 1-12).

Wing 84, bill 17.4, tail 70.

EL **Hypsipetes viridescens viridescens** (Blyth) (Arakan Division, Burma).

2 ♀♀

1 *Mai Village*, *Sandoway Dist.*, 1 *Kyibin*, *Henzada Dist.*, *Burma*.

Wing 79, 84; bill 17, 17.5; tail 70, 73.

The eye colour has not been recorded.

The subspecific identification is based on Deignan *loc. cit.* (1948).

EL **Hypsipetes charlottae propinquus** (Oustalot) (Laichau Province North-western Tongking)

2 o?

1 *Yangte*, 1 *Pimpri Ban*, *N. Shan States*.

These were listed with *H. viridescens* above. The skins appear larger than indicated by the measurements, while the undertail coverts are cinnamon and not yellow. The subspecific identification is based on Deignan *loc. cit.*

Wing 85, 87; bill 16.2, 17; tail 78, 81.

1142 **Hypsipetes nicobariensis** Moore (Nicobars) Nicobar Bulbul 1 : 408

10: 7 ♂♂ 2 ♀♀ 1 o?

6 Camorta, 2 Trinkut, 1 Katchal, 1 Nancowry, Central Nicobars.

♂ No. 22669 from Nancowry has a greyish tinge on the upperparts rendering it paler than any of the others. The wing and bill are the smallest, and this is presumably a juvenile plumage.

Measurements on p. 150.

1143 **Hypsipetes indicus ictericus** (Strickland) (East Indies = Mahableshwar) N. Sahyadri Yellowbrowed Bulbul 1 : 405

9: 5 ♂♂ 3 ♀♀ 1 o?

2 Mahableshwar; 2 Ratnagiri; 2 Molem, Goa; 2 Castle Rock, Goa Frontier (on east).

In *Birds of Goa* (1976 *JBNHS* 73: 50) Grubh and Sálim Ali refer to 5 collected at Valpoi in Goa and identify them as of the nominate form. The four from Molem collected on the same trip are not referred to (being presumably the same birds) but if *ictericus* is recognised, they agree more closely with it. The fifth bird marked as from Valpoi is slightly deeper in colour and may be so accepted as *indicus*. The three accepted races are not very distinct.

Measurements on p. 150.

1144 **Hypsipetes indicus indicus** (Jerdon) (West Coast, restricted to Wynaad) Yellowbrowed Bulbul 1 : 405 (part)

24: 13 ♂♂ 8 ♀♀ 3 o?

1 Valpoi, Goa; 1 Bhowra? (1878 Dr. Anderson), 1 Santgal, 1 Kadra, 2 Karwar, 1 Kumta, 3 N. Kanara; 1 Mercara, Coorg; 1 Gudalur 3000′, 3 Cherambadi, Nilgiri; 1 Ballaji, 1 Honnametti, Billigirirangans, 1 Foothills, 1 4000′ Manalur, 1 Bombay Shola, 1 Cooly Ghat, 1 Palni Ghats; 1 Thettakad, 1 Thekady, Periyar Lake, Travancore.

Measurements on p. 150.

1145 **Hypsipetes indicus guglielmi** (Ripley) (Rakwana, Sabargamuwa Province) Ceylon Yellowbrowed Bulbul

2: 1 ♂ Hunu Wella Estate, Opanake, 1 ♀ Colombo Museum, no data.

The first bird is marked *guglielmi* by Ripley, and is perhaps a slightly deeper olive above and yellow below. This subspecies is restricted to south-western Ceylon, but the other specimen agrees with those more deeply coloured among *indicus* and may perhaps be accepted within the range of variation within the present form.

Measurements on p. 150.

1146 **Hypsipetes mcclellandi mcclellandi** Horsfield (Assam) Rufousbellied Bulbul.

1 : 377

17: 8 ♂♂ 5 ♀♀ 4 o? (1 juv.*)

1 Mornaula, 7600′, 2 Kumaon, U.P.; 1 Chalun Khel, Nepal; 1 Rinchingpong, W. Sikkim, 1 Tung 5650′ Sikkim; 2 Gedu, W. Bhutan; 1 Betase, 2 Narphong, 1 Tama, E. Bhutan; 1 Kalaktang, Arunachal Pradesh, 1 Kohima, Naga Hills, 1 Abor country, Assam; 1 *N'Kraung*, 1 *Upper Burma.*

The birds from the western portion of its range upto and including Sikkim and Naga Hills are more golden green above than the others from Bhutan and northern Assam. They include the older skins from 1900 to 1953 while the others are from 1966-68, and the differences may be due to fading. The measurements are separately shown and it will be noticed that the eastern birds are larger. * This was identified at the Smithsonian by Mr. Bond, having been listed as *P. simplex*, along with a juvenile of *Pycnonotus flavescens.*

Measurements on p. 151.

EL **Hypsipetes mcclellandi tickelli**

3 o?

1 *Sima, Upper Burma;* 1 *Loi Sang,* 1 *Pimpri Bum, N. Shan States, Burma.*

All three have their backs greyish brown rather than green, and less rufous on the underparts making them according to Stuart Baker's Fauna, *binghami* Hartert (Taung, Palaung lat. 21° 46′ N, long. 96° 55′ E, Southern Shan States) but which is synonymised with *tickelli* in Peters (IX p. 290) and whose distribution is said to be Eastern Burma from N. Shan States southwards, through the Southern Shan and Karenni States to Amherst Dist. of Tenasserim.

Measurements on p. 151.

1147 **Hypsipetes flavalus flavalus** (Blyth) (Sub-Himalayan Ranges) Brown-eared Bulbul

1 : 374

36: 16 ♂♂ 16 ♀♀ 4 o?

4 Ranibagh, 1 Kumaon, U.P.; 1 Martam Rongin Valley, 1 Singtam, Teesta Valley, Sikkim; 2 Tama, 1 Deothang, 1 Mangdechu, E. Bhutan; 1 Margherita; 1 Tezu, 3 Dening, Lohit Valley, N.E. Assam, 1 Maya. Dibang, Mishmi; 2 Tirap Div., Arunachal Pradesh; 2 Cherrapunji, Khasi & Jaintia Dist., 2 Kohima. Naga Hills, 1 Rupachena, 1 Laiti Eynsew (?); 2 N. Cachar; 1 Hai *Bum,* 1 *Pun Sin,* 1 *Gora, Chindwin;* 1 *Tawman, Jade Mines, Upper Burma,* 1 *Yante,* 1 *Tangle, N. Shan States;* 2 *Nyamggyo, Prome;* 1 *Aka Hills, Burma.*

The intensity of the grey on the upperparts varies to some extent, but in series the males are darker and also show darker heads, the paler males being presumably birds of the year as is confirmed by their shorter bills.

Measurements on p. 151.

1148 **Hypsipetes madagascariensis psaroides** Vigors (Himalayan Mts. = Simla) Himalayan Black Bulbul 1 : 369

40: 27 ♂♂ (1 juv.) 11 ♀♀ 2 o?

3 Chitral, N.W.F.P.; 1 Srinagar, 1 Moghulmaidan, Kishtwar, Kashmir; 7 Simla, 1 Solon 5000′ Bhagat State, 1 Koti State, 1 Patiala; 4 Garhwal, 2 Marnauli, 1 Konain Jaunsar, 1 Lambathatch, 1 Kumaun, U.P.; 1 Godaveri, 1 Nagarcot, 1 Chalnakhel, Nepal; 2 Temi, West Sikkim; 3 Darjeeling; 1 Honka, West Bhutan, 4 Gomchu, 1 Rontang, E. Bhutan, 1 Shangon, Bhutan, 1 Hasnia Tea Estate, Bhutan Duars.

Juvenile ♂ No. 16202 from Simla has the head sparsely feathered and the throat whitish. The colour of the bill and legs, where noted is said to be coral-red but is now yellow in all. All have white margins to the undertail coverts. There is variation in the shade of the grey both above and below.

Measurements on p. 151.

1149 **Hypsipetes madagascariensis ganeesa** Sykes (Ghauts, Dukhun) South Indian Black Bulbul 1 : 372

19: 14 ♂♂ (1 juv.) 5 ♀♀

2 Bhimashankar, Poona; 2 Castle Rock, N. Kanara; 1 Belimane, Sagar, Shimoga, Mysore; 2 Avalanche, 1 Wynaad, Nilgiris; 5 Shembaganur, 1 Palnis, Madura Dist., 2 Honametti, Billigirirangans; 1 Muthukuzi, Ashambo Hills; 2 Shevaroy Hills, Salem Dist.

This subspecies has no black stripe below the eye and the tail is less conspicuously forked than in the Himalayan race. In life the bill is bright orange which dries to yellow as in the last. The bill of the juvenile is now dark.

Measurements on p. 151.

1150 **Hypsipetes madagascariensis humii** (Whistler & Kinnear) (Ceylon) Ceylon Black Bulbul

2: 1 ♂ 1 ♀ near Kundava, Sinharaja, Ratnapura, Sri Lanka.

The two fresh skins are now much greyer than the others (*ganeesa*) and have the bills reddish *cf.* yellow.

Measurements on p. 151.

1151 **Hypsipetes madagascariensis nigrescens** Stuart Baker (Upper Chindwin) Assam Black Bulbul 1 : 371

8: 6 ♂♂ 1 ♀ 1 o?

1 Laising, N. Cachar, 1 Naga Hills, 1 Cherrapunji, Khasi & Jaintia Hills, 1 Assam; 1 *Nyaunggyo, Prome dist.,* 1 *Mindon Yoma,* 1 *Thayetmyo;* 1 *Tongme (Pomed), Burma.*

These are brown rather than grey above, Some are marked *nigriscens* by an earlier worker. The black of the head is distinct from the upper back. Some have the feathers of the upper back centrally streaked with black.

Measurements on p. 151.

EL **Hypsipetes madagascariensis concolor** Blyth (Tenasserim) Burmese Black Bulbul 1 : 372

1 o? Sp. No. 1831 *Thangaung, Burma.*

1111 **Spizixos canifrons canifrons**

	Wing	Bill	Tail
♂ (1)	95	15.5	84
♀♀ (2)	92, 95	15.4, 15.5	85, —
o? (2)	91, 97	15.2, 15.5	86, —
	(IH ♂♀ 90-102	from skull 16-19	89-99)

1112, 1113 **Pycnonotus atriceps atriceps & P. a. fuscoflavescens**

♂ 1112 *atriceps* (2)	86, 86	14, x	70, 70
♀ 1112 *atriceps* (2)	83, 85	13, 14.5	69, 69
	(IH ♂♀ 80-86	13-14	c. 84)
♂ 1113 *fuscoflavescens* (5)	79-81 av. 79.6	15.1-15.5 av. 15.3	65-68 av. 66.4
♀ 1113 *fuscoflavescens* (3)	77, 77, 78	15.2, 15.5, 15.8	67, 68, 70
	(IH as in nominate *atriceps*)		

1114 **Pycnonotus priocephalus**

♂♂ (8)	76-79 av. 77	12.8-14.4 av. 13.4	70-75 av. 72
	(IH 75-79	from skull 14-17	70-79)
♀♀ (2)	74, 78	12.6, 13.2	69, 71
	(IH 75-77	from skull 14-16	70-73)

1115/7 **Pycnonotus melanicterus flaviventris, P. m. gularis** and **P. m. melanicterus**

1115 ♂♂ *flaviventris* (23)	84-94 av. 89.8	13.7-15.5 av. 14.5	77-89 av. 82.9
	(IH 85-95	from skull 14-17	82-90)
1116 ♂♂ *gularis* (4)	72-82 av. 77	14-15.2 av. 14.5	67-73 av. 71
	(IH 74-79	from skull 15-16	68-74)
1115 ♀♀ *flaviventris* (14)	84-93 av. 87.7	13.2-15.3 av. 14.3	73-84 av. 80.2
	(IH 83-89	from skull 14-16	79-86)
1116 ♀♀ *gularis* (6)	72-79 av. 74	13-14.3 av. 13.7	64-69 av. 66.8
	(IH 73-79	from skull 15-16	67-69)
1117 ♀ *melanicterus* (1)	71	13.2	65
	(IH 72-74	from skull 15-16	62-65)

1118/22 **Pycnonotus jocosus** subspp.

	Wing	Bill	Tail
♂♂			
1120 *fuscicaudatus* (21)	80-91 av. 86.5	15.7-18.5 av. 17	75-85 av. 80
	(IH 81-95	from skull 17-20	78-87)
1121 *emeria* (6)	83-88 av. 85	15-16 av. 15.5	75-83 av. 78.3
	(IH 80-88	from skull 17-19	75-84)
1121a *monticola* (8)	83-96 av. 91	16-17.1 av. 16.5	81-91 av. 85.5
	(IH 84-95	—	—)
1122 *whistleri* (7)	80-85 av. 82.6	16.7-17.8 av. 17.4	74-81 av. 77.7
	(IH 81-95	from skull 17-20	78-87)
♀♀			
1118 *pyrrhotis*	81 (IH 80-83)	14.8 (from skull 19)	70 (73-77)
1120 *fuscicaudatus* (7)	81-87 av. 83	15.2-16.5 av. 15.7	75-87 av. 78.8
	(IH 80-85	from skull 18-19	77-81)
1121 *emeria* (6)	79-86 av. 81.6	15.2-17.3 av. 16	71-82 av. 76.1
	(IH 78-84	from skull 16-19	72-79)
1121a *monticola* (2)	87, 92	16.3, 17.2	83, 87
	(IH 80-91	—	—)
1122 *whistleri* (6)	79-81 av. 79.5	16.2-17.9 av. 17.3	71-76 av. 74
	(IH 80-85	from skull 18-19	77-81)

1123 *et seq* **Pycnonotus leucogenys** subspp.

	Wing	Bill	Tail
♂♂			
1123 pale *leucotis* (4)	77-87 av. 83	14.5-15.3 av. 14.8	70-77 av. 74.5
1123 dark *leucotis* (8)	84-92 av. 85.3	13.1-15.5 av. 14.6	75-83 av. 77.8
	(IH 81-91	from skull 15-18	66-84)
1124 *humii* (4)	92-94	15-16	79-80
	(IH 85-94	from skull 19-21	81-90)
1125 *leucogenys* (14)	87-100 av. 91.4	15.6-18.2 av. 16.5	77-95 av. 84.5
	(IH 85-94	from skull 19-21	81-90)
cafer x *leucogenys* ♂ (1)	101	17	95
EL mss. *lapersonnei* (2)	86, 86	—, 14.8	76, 77
EL *mesopotamiae* (6)	91-94 av. 92.8	15-17.7 av. 16.8	84-89 av. 86.2
♀♀			
1123 pale *leucotis* (8)	74-86 av. 81	13.1-16 av. 14.4	69-77 av. 72.3
1123 dark *leucotis* (7)	80-88 av. 82.5	14-15.8 av. 14.8	68-81 av. 76.3
	(IH 80-88	from skull 14-16	73-80)
1124 *humii* (2)	85, 88	15, 15.5	79, 80
	(IH 82-86	from skull 18-19	80-86)
1125 *leucogenys* (13)	86-91.5 av. 88.4	14-16.6 av. 15.9	75-86 av. 81.7
	(IH 82-86	from skull 18-19	80-86)
cafer x *leucogenys* ♀ (1)	97	17	89
EL mss. *lapersonnei* (2)	85, 86	14.6, 16	78
EL *mesopotamiae* (6)	91-94 av. 92.8	15-17.7 av. 16.8	84-89 av. 86

1126/32 **Pycnonotus cafer** subspp.

	Wing	Bill	Tail
♂♂			
1126 *intermedius* (5)	102-107 av. 103.8	18.2-18.4 av. 18.3	94-102 av. 96.8
	(IH 100-110	from skull 19-22	93-103)
1127 *humayuni* (8)	91-99 av. 94.5	15.3-18.4 av. 16.5	73-86 av. 81.2
	(IH 92-101	from skull 19-21	79-95)
1128 *cafer* (16)	92-101 av. 95.6	15.7-18.4 av. 16.8	78-91 av. 83
	(IH 90-99	from skull 19-21	74-89)
1129 *haemorrhousus*	(IH 93-94	from skull 20-21	77-80)
1130 *wetmorei* (4)	90-97 av. 94.7	16.5-18.5 av. 17.2	77-84 av. 81.7
	(IH 89-99	from skull 18-19	79-89)
1131 *bengalensis* (17)	98-108 av. 104	18.1-21.2 av. 19.2	91-100 av. 96.8
	(IH 96-107	from skull 21-23	90-103)
1132 *stanfordi* (5)	97-107 av. 103	18.1-21 av. 20	87-98 av. 94.6
(incldg 3 o?)	(IH as in *bengalensis*)		
EL *melanchimus*	98	20.3	93
♀♀			
1126 *intermedius* (5)	95-103 av. 98	17.1-19 av. 17.9	89-97 av. 92.5
	(IH 90-102	from skull 18-20	84-96)
1127 *humayuni* (8)	89-95 av. 91.7	15.7-16.9 av. 16.2	79-86 av. 82.2
	(IH 87-95	from skull 17-19	78-89)
1128 *cafer* (11)	87-96 av. 90.6	14.5-17.6 av. 16.4	73-85 av. 79
	(IH 85-98	from skull 19-21	74-83)
1129 *haemorrhousus*	[IH (2) 91	from skull 20	74, 76]
1130 *wetmorei* (8)	88-96 av. 91.6	15.2-17.5 av. 16.3	78-85 av. 80.5
	[IH (3) 84-93	from skull 17-18	75-83]
1131 *bengalensis* (8)	99-105 av. 100.7	17-20 av. 18.3	88-97 av. 92.5
	(IH 89-102	from skull 19-22	85-95)
1132 *stanfordi* (1)	95	19	89

1133/4 **Pycnonotus striatus striatus/arctus**

♂♂			
1133 *striatus* (4)	103*, 111(2), 113	16.6*-17.7	94*-98
	(IH 102-114	from skull 20-24	98-106)
1134 *arctus* (3)	103*, 110, 113	15.2*-17.3, 17.7	92*, 97, 101
	(IH 105-118	18-21	—)
♀♀			
1133 *striatus* (6)	108-114 av. 109.8	16.5*-18.5 av. 17.3	96-110 av. 98
	(IH 98-107	from skull 19-22	97-103)

* Specimen Nos. 1864 and 1866 referred to in text.

1135 **Pycnonotus xantholaemus**

	Wing	Bill	Tail
♂♀ (4)	87-91	14-14.5	84-87
	(IH 87-92	from skull 17	85-86)

1136 **Pycnonotus penicillatus**

o? (2)	80, 82	15.3, 15.6	74, 78
	(IH ♂♀ 76-87	from skull 17-19	72-81)

1137 **Pycnonotus f. flavescens** and **P. f. vividus**

1137 *flavescens* ♂ (1)	89	14	97
flavescens ♀ (1 juv.)	87	13.6	87
	(♂♀ 81-87 mm.	about 10 mm	about 100)
EL. *vividus* o? (2)	89, 90	14, 14.4	95, 97
	(♂♀ 80-89)		

1138 **Pycnonotus luteolus luteolus**

♂♂ (11)	87-92 av. 89.3	15.7-17.5 av. 16.5	75-85 av. 80.8
	(IH 82-93	from skull 18-20	75-86)
♀♀ (12)	84-90 av. 86	15.3-17.8 av. 16.4	75-82 av. 78.5
	(IH 86-90	from skull 18-20	74-82)

EL. **Pycnonotus finlaysoni finlaysoni/davisoni**

nominate *finlaysoni* ♂ (1)	77	16.2	77
	(♂♂ 75-87	about 15	about 85)
davisoni ♂♂ (3)	84, 88, 89	15.7, 17.5, —	80, 83, 85
„ ♀♀ (3)	84, 86, 89	15.5, 16.7, 16.8	80, 80, 85

("a slightly bigger bird than Finlayson's Bulbul, the wing running from 76 to 90 mm")

EL **Pycnonotus blanfordi blanfordi**

♂♀	82-88 av. 84	16.5-16.8 av. 16.6	75-84 av. 79
	(85-89	about 15mm)	

El **Hypsipetes thompsoni**

♂♀ (3)	90, 90, 82	17.5, 17.5, 18.2	81, 85, 87
	(ex. Bingham ♀ 3.7, 3.8 inches	from gape ♂ 0.85, ♀ 0.85	♂ 3.8, ♀ 3.85)

1140 *et al.* **Criniger flaveolus flaveolus**

	Wing	Bill	Tail
♂♂			
(a) *flaveolus* (14)	100-109 av. 105	17.3-21.1 av. 19.3	83-94 av. 88.6
	(IH 101-107	from skull 20-25	92-102)
(b) Chindwin (3)	100, 101, 104	18 (2), 20	84,, 86, 87
(c) *burmanicus* (?)	100	17	85
♀♀			
(a) *flaveolus* (9)	99-108 av. 103.8	18.5-21.2 av. 19.2	83-91 av. 86
	(IH 98-105	from skull 20-23	88-93)
(b) Chindwin (3)	100, 101, 106	17, 19, 20	81, 87, 88
(c) *burmanicus* (?)	99	18.5	77

1142 **Hypsipetes nicobariensis**

	Wing	Bill	Tail
♂♂ (7)	101-105 av. 103.3	22-24 av. 22.4	85-91 av. 88
	(IH 97-102	from skull 23-25	83-87)
♀♀ (2)	101 (2)	20, 20.5	84, 85
	(IH 92-100	from skull 24	80-84)

1143-45 **Hypsipetes indicus** subspp.

	Wing	Bill	Tail
♂♂			
1143 *ictericus* (5)	89-95 av. 92	17.5-19.1 av. 18.5	75-82 av. 78.6
	(IH 90-97	from skull 18-21	76-87)
1144 *indicus* (12)	92-98 av. 94.7	17.5-20 av. 19	77-88 av. 81
	(IH 88-97	from skull 19-21	75-87)
1145 *guglielmi*	91	17.4	88
	(IH 87-91	18-19	74-79)
♀♀			
1143 *ictericus* (3)	81, 91, 95	17.8, 18.2 (2)	76, 79, 81
	(IH 88-91	from skull 18-20	75-83)
1144 *indicus* (6)	87-93 av. 90.3	16.8-18 av. 17.6	74-81 av. 77
	(IH 89-91	from skull 19-21	77-83)
1145 *guglielmi*	93	18.8	80
	(IH 91	19	79)

1146 *et al.* **Hypsipetes mcclellandi** subspp.

♂♂	Wing	Bill	Tail
1146 nominate (a) (4)	102-112 (106.5)	20.5-22 (21.4)	96-106 (99)
nominate (b) (4)	101-115 (110.5)	20.5-23-9 (22.4)	96-108 (102)
	(IH 100-112	from skull 24-29	98-113)
EL *tickelli* ♂♀ (3)	104, 109 (2)	21, 22.9, 23	100, 107, 106
♀♀			
1146 nominate (a)	100, 102	20.5 (2)	93, 100
nominate (b) (3)	103, 105 (2)	22.6, 23.2, 24.5	95, 95, 105
	(IH 100-109	from skull 25-27	93-109)

1147 **Hypsipetes flavalus flavalus**

♂♂ (15)	94-105 av. 100.9	16-19 av. 17.4	82-93 av. 87.8
	(IH 94-105	from skull 20-22	85-95)
♀♀ (16)	90-105 av. 97.7	15.2-17.7 av. 16.6	80-90 av. 85.4
	(IH 89-98	from skull 20-22	81-90)

The smallest measurements, particularly of the bill, are of juveniles or birds of the year.

1148 *et al.* **Hypsipetes madagascariensis** subspp.

♂♂	Wing	Bill	Tarsus	Tail
1148 *psaroides* (26)	117-132 av. 125.6	22-26.4 av. 24.3	14.5-19.5 av. 16.8	94-118 av. 106.5
	(IH 116-130	from skull 26-29	20-22	102-116)
1149 *ganeesa* (13)	117-123 av. 120.5	23.5-26.5 av. 24.9	15-19 av. 17	96-103 av. 99.5
	(IH 112-124	from skull 26-29	16-18	98-105)
1150 *humii* (1)	124 (IH 118-128)	26.7	20.5 (18-19)	100 (98-104)
		(from skull 27-32)		
1151 *nigrescens* (6)	115-128 av. 123	23.5-26 av. 24.5	16-18.5 av. 17.5	92-110 av. 100.3
	(IH as in 1148)			
♀♀				
1148 *psaroides* (11)	117-129 av. 119.6	22.4-25.5 av. 23.6	15-19.5 av. 16.7	97-106 av. 101.5
	(IH 111-124	from skull 26-28	20-21	93-111)
1149 *ganeesa* (5)	110-117 av. 113.8	22.8-25 av. 23.8	15-18.5 av. 17.3	91-98 av. 94.4
	(IH 107-123	from skull 24-28	16-17	92-104)
1150 *humii* (1)	115 (IH 116, 117)	25 (27, 28)	18 (18)	93 (94, 100)
1151 *nigriscens* (1)	114	25	17.2	92
EL *concolor* o?	123	16.7	14.6	95

(*to be continued*)

ON A NEW SUBSPECIES OF *PELLORNEUM RUFICEPS* (SWAINSON) IN PENINSULAR INDIA[1]

HUMAYUN ABDULALI

It has been customary to accept specimens of *Pellorneum ruficeps* (Swainson) from all over Peninsular India, excluding the southwest whence *granti* has been described, as of the nominate form with the type locality in the Nilgiris.

Some years ago while going through the Bombay collection for determination of the subspecies to be included in the *Checklist of the Birds of Maharashtra,* I had noticed that the series collected in the Eastern Ghats by the Vernay Scientific Survey (1929-30) appeared very different from specimens from other parts of India, but in the absence of topotypes no action was possible. The same problem presented itself again when cataloguing the birds in the Bombay collection but I have now been able to give the matter some more attention.

The bird was originally described from India by Swainson, 1832, Fauna Boreali Americana p. 487, but Stuart Baker (1921, p. 238) said the type locality was the Nilgiris. Deignan (1947) explained that "many, if not all, the specimens listed by Swainson, in Fauna Boreali Americana came into Gould's possession" and "the type specimen is probably the one from the Nilgiri Hills, ex Gould's collection recorded by Bowdler Sharpe, Catalogue of Birds in British Museum, Vol. 7, 1883, p. 251." He then restricted the type locality to Coonoor, Nilgiri Hills Dist., Madras Presidency.

Kinnear & Whistler (1930, p. 393) when reporting on the first lot of birds collected by the Vernay Scientific Survey of the Eastern Ghats referred to five specimens of *Pellorneum ruficeps* obtained at Kurumbapatti, Salem dist., Madras, in the low country about half a mile from the Shevaroy Hills. Here they indicated the type locality as the Nilgiris and said:

"The above series appears to be indistinguishable from Nilgiri birds. Harington originally confined his dark race *granti* to Travancore and we are not certain that the Fauna is right in attributing to it also the birds from Coorg, the Wynaad and South-West Mysore. A fine series of the species is coming in from some of the later collecting camps and it should be possible later on to speak more positively of the distribution of the races of this common bird".

Later when reporting on the whole collection, 1932, *JBNHS* 35, pp. 746-747 they quoted the same source for Swainson's original description but reverted to "India" as the type locality. The series of 36 skins then available from Kurumbapatti, Shevaroy Hills, and northwards along the ghats to Anantgiri, Sankrametta, and Jaipur, in the Vizagapatnam Hills, was said to be remarkably constant in size and coloration though there was a tendency for the coloration to grow slightly richer in tint in the north-east about Orissa, but not sufficient to warrant a subspecies".

This reversion from the Nilgiris to India, the failure to refer to any specific specimens from the Nilgiris (which are scarce in collections) or to compare the Orissa birds with those from other parts of India suggest some

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[1] Accepted November 1981.

confusion and the possibility of only the first specimens from Kurumbapatti (actually intermediate between the Nilgiri birds and the new race and once said to be indistinguishable from the Nilgiri birds) being compared with the new arrivals and all being named as nominate *ruficeps,* while the north-eastern birds which are darker and closer to those from the Nilgiri's and other parts of India are said to be different from *ruficeps,* but not separable.

This confusion has led to all the birds from Peninsular India, excluding the dark birds from the south-west (*granti*) being lumped together as *ruficeps.*

A glance at the fair series available from the Shevaroy Hills, Chitteri Range and Palkonda Hills, immediately shows that they are very distinct from all the others available, in having pale upperparts with a faint olive green wash and also a much paler rufous cap. The British Museum have been kind enough to lend me some specimens including one collected by H. R. Baker at Segoor 4000′, Nilgiris, and others from the different collecting camps of the Eastern Ghats Survey.

With the examination of even one specimen from the Nilgiris, I have no hesitation in deciding that though those from Kurumbapatti in the low country are intermediate, the others further north along the Eastern Ghats are quite different from *ruficeps* from the Nilgiris and I name them:

Pellorneum ruficeps pallidum subsp. nov.

Type: B.N.H.S. Sp. No. 1259 ♂ (Collector's No. 650) collected by V. S. La Personne at 1000′ in Palkonda Hills, South Cuddapah, Madras, on 4th August 1929.

9 cotypes: 7 ♂♂ 2 ♀♀ (all April to August 1929) 1 3500′, 1 4000′ Shevaroy Hills; 1 2000′, 1 3000′, Chitteri Range, Salem dist.; 5 1000′ Palkonda Hills, South Cuddapah, Madras.

4 specimens from Palkonda and Shevaroy Hills and Chitteri Range from the British Museum all agree with the above. All the specimens, both in Bombay and from Tring, were collected by V. S. La Personne during the Eastern Ghats Survey.

Diagnosis: Olive green of upperparts and chestnut of head strikingly paler than in *ruficeps* from the Nilgiris and further west and north along Western Ghats. A similar character separates *punctatum* from *mandelli* in the north and is referred to as "a greyish cast" by Deignan (1947).

Specimens listed above cover the known range of the subspecies though Bowdler Sharpe (loc. cit.) refers to a specimen from Madras (Dr. Jerdon) in which the general cast of the plumage is ashy and the crown only slightly more rufescent than the back. He also mentions that the superciliary streak is whitish. We do not know how close to Madras this species is now found, but the description is suggestive of this race.

The Spotted Babbler is common in well-wooded localities over most of India, Burma, China, Thailand, and other parts of south-east Asia, and 26 subspecies are listed in Peters' Checklist Vol. X (1964). Deignan (loc. cit., p. 4) "after seeing the variations in the populations in the countries to the east, finds it "difficult to believe that a careful study of good series will not show that in India also considerable subspeciation occurs.........."

One good series has been found distinctly different, and I have no doubt that further study will endorse his remarks.

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NEW DESCRIPTIONS

STUDIES ON SOME APHELINID (HYM.: CHALCIDOIDEA) PARASITES OF HEMIPTEROUS INSECTS OF INDIA[1]

TASAWWER HUSAIN AND MAN MOHAN AGARWAL[2]

(*With twenty-five text-figures*)

Three new Aphelinid species viz., *Eretmocerus hydrabadensis; Azotus aleuroides* and *Physcus oriensis* have been described. *Prospaltella clypealis* Silvestri has been redescribed in greater detail. Keys to Indian species of *Eretmocerus* and *Physcus* have also been proposed.

Eretmocerus Haldeman

Haldeman, 1850. Amer. Jour. Sci. Arts. 9 (2): 111.

Type species: *Eretmocerus corni* Haldeman.

The genus can be easily separated from allied genera of the family by the:

Five segmented antennae with two annular funicle segments and a long unsegmental club; four segmented tarsi. Characters suggested by Hayat (1972) apply well to the species, namely, "pronotum consisting of two triangular lobes joined in the middle by a membrane; subgenital plate broad, posterior margin with a notch in the middle; outer plates of ovipositor with submarginal ridge along dorsal margin".

Fletcher (1914) reported for the first time an undescribed species bred from castor whitefly. Mani (1941) described a new species based on male. Samuel (1950) reported *E. masii* Silv. Hayat (1972) added three new species. namely, *E. indicus* Hayat, *E. mashhoodi* Hayat and *E. gunturiensis* Hayat.

KEY TO INDIAN SPECIES OF THE GENUS *Eretmocerus* HALDEMAN BASED ON FEMALES[3]

1. Pedicel three or more than three times longer than wide 2
— Pedicel less than three times longer than wide 5
2. Marginal vein longer than stigmal..........3
— Marginal vein as long as stigmal............ ....*E. haldemani* Howard
3. Speculum bounded by two or more than two rows of setae..............................4
— Speculum bordered by a single row of setae; submarginal with two setae; marginal fringe 1/6 of wing disc ....*E. indicus* Hayat
4. Speculum bordered by two rows of setae; first funicle segment triangular; scutellum with 4 setae; thorax and gaster yellow............. ....*E. mashhoodi* Hayat
— Speculum bordered by two complete and third incomplete row of setae; first funicle ring like; scutellum with 6 setae; thorax light brown, gaster dark..........*E. hydrabadensis* sp. nov.
5. Club spatulate; first funicle triangular or quadrate 6
— Club cylindrical; first funicle ring like, much shorter than second; club nine times as long

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[1] Accepted June 1981.

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[3] *E. masii* Silvestri and *E. delhiensis* Mani are not included in the key as they are recorded from males.

as wide; speculum bordered by 11 setae............................. *E. gunturiensis* Hayat

6. First funicle triangular, second wider than long.......................*E. corni* Haldeman

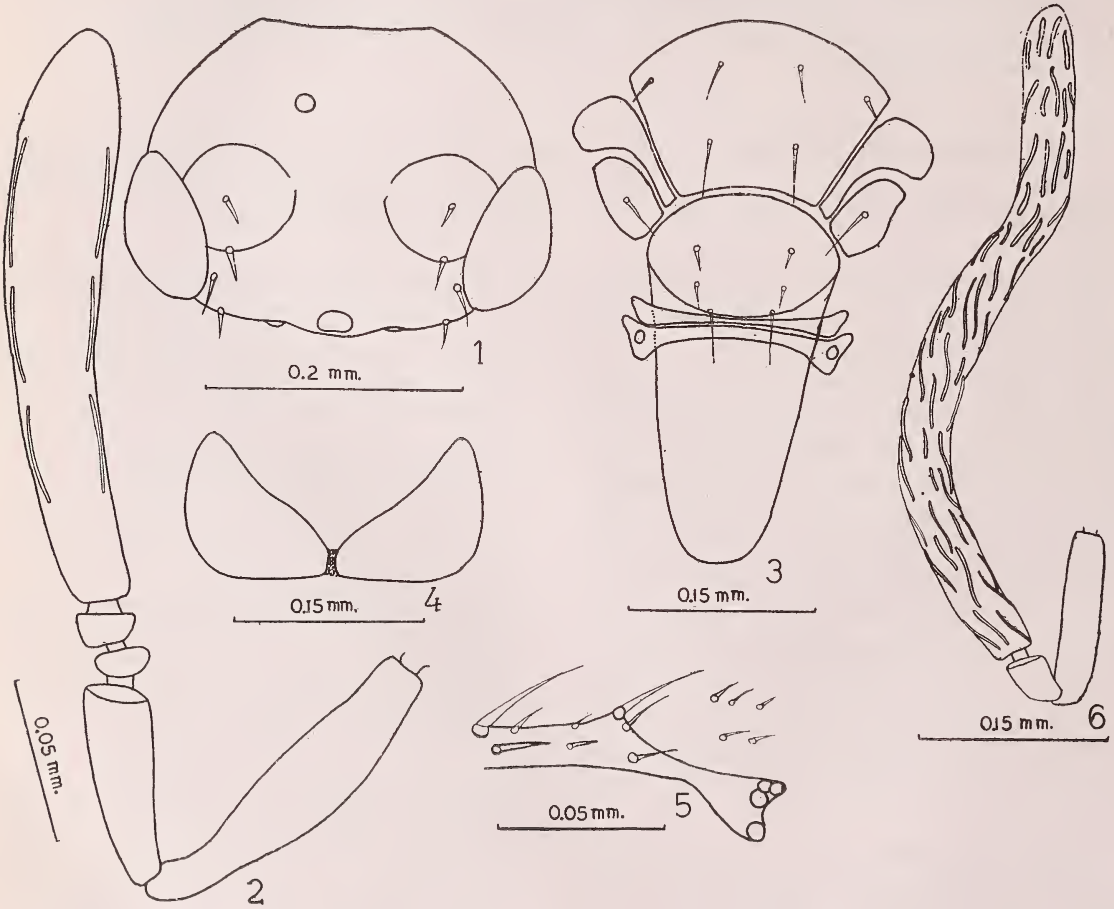
— First funicle quadrate; second longer than wide ....*E. mundus* Mercet

Eretmocerus hydrabadensis sp. nov.
(Figs. 1-6)

FEMALE

Head (Fig. 1) — Light brown, wider than long in facial view (O.31: O.23); vertex sparsely setose, frons with few setae; eyes dark; malar space more than the longitudinal diameter of eyes (O.14: O.12); ocelli in obtuse angled triangle, basal ocellus removed from occipital margin by about its own diameter (0.02) and from eye rim by slightly more than its own diameter; maxillary palpi two segmented, labial palpi unsegmented; mandibles tridentate.

Antennae (Fig. 2) — Whitish; scape about four times as long as wide (0.1 : 0.025); pedi-



Figs. 1-6. *Eretmocerus hydrabadensis* sp. nov.
1. Head (facial view); 2. Antenna ♀; 3. Thorax; 4. Pronotum; 5. Part of forewing venation; 6. Antenna ♂.

cel three and a half times as long as wide (0.07 : 0.02); first funicle segment ring like, second one and a half times wider than long; club about six times (0.17 : 0.03) as long as wide with three pairs of sensoria on margins.

Thorax (Fig. 3) — Light brown, pronotum orange yellow with two (Fig. 4) lobes joined in the middle by a membrane; axillae somewhat triangular with a single seta; parapsides hammer shaped, broad at apex, narrow at base; scutum and scutellum with 6 setae each; metanotum a transverse strip; mesopostphragma long, reaching upto middle length of abdomen, rounded at apex.

Forewings — Hyaline, less than three times as long as wide, (0.65 : 0.25), marginal vein shorter than submarginal, about one and a half times as long as stigmal (0.08 : 0.05) (Fig. 5), postmarginal absent; speculum mesally bounded by twenty setae arranged in two complete and a third incomplete row; marginal fringe short.

Hind wings — Hyaline, long, narrow, about ten times longer than wide; marginal fringe long, longer than wing disc.

Legs — Coxae and femora orange yellow except at apex and base, apex and base of femora, tibiae and tarsi whitish.

Gaster — Dark brown, longer than thorax; ovipositor slightly exserted arising from base of gaster; subgenital plate broad anteriorly with anterior margin straight, posterior margin narrow with a notch in the middle; first valvifers somewhat triangular; second valvifers with outer margin thickened; third valvulae movably articulated with second valvifers; outer plates of ovipositor narrow at base, broad at apex with a ridge along dorsal margin.

Female length : 0.87 mm

MALE — resembles the female, except for the following differences:

Antennae (Fig. 6) three segmented; scape about four times longer than wide (0.15:0.04); pedicel slightly longer than wide (0.4:0.03); club unsegmented about twelve times as long as wide (0.51:0.043) with many sensoria.

Male length: 0.81 mm.

Material studied: Holotype ♀ and ♂ India, Andhra Pradesh, Hyderabad ex white-fly on *Nerium odorum*, 3.X.1977 (T. Husain). Paratypes 2 ♂♂. Data same as for holotype. Material deposited with Zoology Museum, Department of Zoology, AMU Aligarh.

Genus *Azotus* Howard

Azotus Howard, 1898: Proc. Ent. Soc. Wash. 4:138.

Type species; *Azotus marchali* Howard

Dimacrocerus Brethes, 1914: Nunguam Otiosus, Buenos Aires: 4

Type species: *Dimacrocerus platensis* Brethes

This genus can be easily distinguished from others by the: seven segmented antennae with varied colours, four segmented funicle and an unsegmented club. Zinna (1962), Agarwal (1964) and Jasnosh (1966) suggested some new characters of the pronotum, subgenital plate and components of the female genitalia which are quite helpful in the generic diagnosis and have proved stable.

A. delhiensis Lal, 1938 was the first record from India. Agarwal (1964) described two new species and Khan & Shafee (1976) added three new species (all based on females). A new species *A. aleuroides* is being described, based on Male.

Azotus aleuroides sp. nov.

(Figs. 7 & 8)

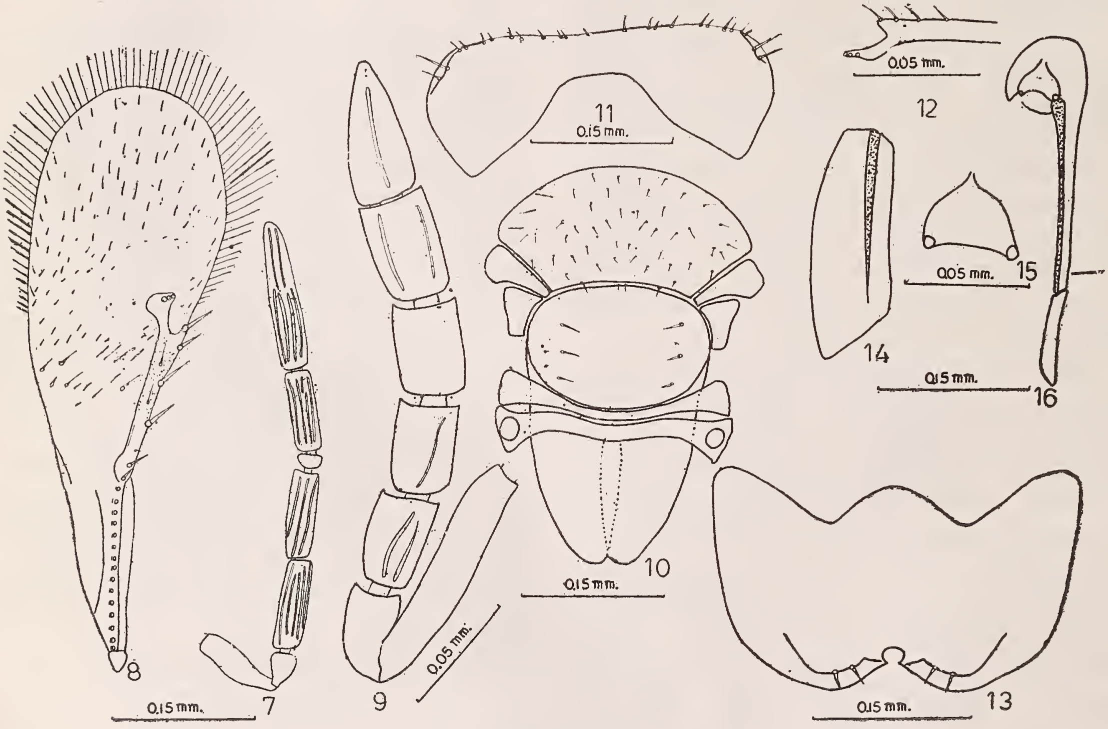
MALE

Head — Light brown, vertex orange yellow, eyes red, wider than long in facial view; ocelli in acute triangle, basal ocellus removed from eye rim by about its own diameter (0.02) and from occipital margin by three times its diameter; antennae inserted very close to oral margin; maxillary palpi two segmented; labial palpi unsegmented; mandibles tridentate.

Antennae (Fig. 7) — Light brown; scape about three times as long as wide (0.09:0.03); pedical about one and a half times as long as wide (0.035 : 0.025), first, second and fourth funicle segments subequal, slightly more than three times as long as wide (0.09 : 0.029), third funicle ring like; club unsegmented, about six times as long as wide (0.16 : 0.027), as long as preceding two and half of second funicle segment combined; first funicle to club except third, with 5, 3, 4 and 6 sensoria respectively.

Thorax — Scutellum and scutum dark brown, light brown on remaining part; pronotum with anterior and posterior margins deeply concave, anterior margin with a wide notch in the middle; parapsides and axillae with one seta each; scutum and scutellum with a pair of setae each; mesopostphragma rounded at apex.

Fore wings (Fig. 8) — About three times as long as wide (0.6 : 0.2); without infuscated bands, disc with sparsely arranged dark setae, area below stigmal vein without setae; costal



Figs. 7-8. *Azotus aleuroides* sp. nov.
7. Antenna ♂; 8. Forewing.
Figs. 9-16. *Physcus oriensis* sp. nov.
9. Antenna ♀; 10. Thorax; 11. Pronotum; 12. Part of forewing venation; 13. Subgenital plate; 14. Outer plate of ovipositor; 15. First valvifer; 16. Second and third valvulae.

cell broad; submarginal as long as marginal (0.15), submarginal vein with a single seta and 14 bullae on its posterior margin; marginal comparatively thick with five setae, postmarginal reduced, stigmal expanded at apex; marginal fringe about one-fourth wing width.

Hind wings — Hyaline, more than six times longer than wide; marginal fringe long, longer than wing width.

Legs — Light brown except at apex and base of tibiae and tarsi whitish.

Gaster — Dark brown.

Male length: 0.89 mm.

Material studied — Holotype ♂, India, Uttar Pradesh, Aligarh. ex. white-fly on *Citrus medica*, 10.IX.1977 (T. Husain). Zool. Mus-AMU.

Comments — *A. aleuroides* sp. nov. is very close to *A. delhiensis* Lal, but differs from it, in the absence of infuscated bands on the fore wings and in the presence of a reduced postmarginal vein.

Genus *Physcus* Howard

Physcus Howard, 1895: U. S. Deptt. Agric. Bur. Ent. Tech. Ser. Bull. 1:43

Type species: *Coccophagus varicornis* Howard

This genus can be distinguished from allied genera by the: 7-segmented antennae of varied colour with all the three funicle segments subequal and a two segmented club. Additional characters suggested by Hayat (1971), "Outer plates of ovipositor narrow at base, gradually widening posteriorly with a submarginal ridge and obliquely truncated at apex; posterior margin of sebgenital plate with a notch in the middle, knobs on either side of the notch followed by laterally directed ridges", are stable and useful in generic diagnosis. We are in agreement that the shape of the pronotum-having expanded lateral lobes joined by a narrow bridge in the middle, can also be tested at the generic level.

Five species have so far been described from India namely *P. albipodus* Agarwal, *P. flaviceps* Girault *et al.; P. reticulatus* Compere *et al.; P. compere* Hyat, *P. gunturiensis* Shafee. A new species *P. oriensis* is added and a key to Indian species of the genus based on females proposed.

KEY TO INDIAN SPECIES OF THE GENUS *Physcus* HOW. BASED ON FEMALES

1. Body predominently black or brown........2
— Body yellow, funicle I and II dark brown.... ....*P. flaviceps* Girault & Dodd
2. Club distinctly shorter than funicle..........3
— Club as long as funicle; scape four times as long as wide; pedicel as long as first funicle; funicle II and III pale yellow; abdomen brown.......*P. reticulatus* Compere & Annecke
3. Club brown 4
— Club yellow 6
4. Second funicle orange yellow...............5
— Second funicle light brown, scape four times as long as wide; submarginal vein with 16 setae and 12 bullae; postmarginal vein absent...... ....*P. albipodus* Agarwal
5. Postmarginal vein absent; abdomen pale yellow, sides of dorsum and ventre with brown spots reaching upto cercal plates....*P. compere* Hayat
— Postmarginal vein slightly developed; abdomen brown without spots..*P. gunturiensis* Shafee *et al.*
6. Scape brown except apex, one and two funicle pale yellow; gaster white with a longitudinal brown band on either side..*P. aligarhensis* Hayat
— Scape light yellow, first funicle dark, second white; gaster rusty and without bands....... ....*P. oriensis* sp. nov.

Physcus oriensis sp. nov.

FEMALE

Head — Rust coloured, wider than long in facial view (0.35 : 0.22); sparse setae on vertex and frons; occipital margin rounded; frontovertex longer than wide (0.30 : 0.25); eyes dark; ocelli in obtuse triangle, basal ocellus removed from eye rim and from occipital margin by about its own diameter (0.15);

antennal sockets just above the ventral margins of eyes; malar space less than eye length (0.12 : 0.15); maxillary palpi two segmented, labial palpi unsegmented; mandibles tridentate.

Antennae (Fig. 9) — Scape and pedicel light yellow, first funicle dark, second white, remaining orange yellow; scape about five and a half times as long as wide (0.10 : 0.019); pedicel less than twice as long as wide (0.035: 0.02); club two segmented, less than four time as long as wide (0.1 : 0.028), as long as preceding two and half of first funicle segment combined.

Thorax (Fig. 10) — Rust coloured; pronotum (Fig. 11) having expanded lateral lobes joined by a narrow bridge in the middle, anterior margin deeply notched in the middle, posterior margin with a row of sixteen submarginal setae; scutum as long as but wider than scutellum, with sparse setae; scutellum with three pairs of setae; parapside narrow at base, broad at apex; axillae somewhat triangular; mesopostphragma long and notched at apex.

Forewings — Hyaline, about three times as long as wide (0.68 : 0.22), disc profusely ciliated; costal cell broad; submarginal and marginal veins subequal (0.22), stigmal five times longer than short postmarginal (Fig. 12); marginal fringe short.

Hind wings — Hyaline, about five times longer than wide; marginal fringes long, more than half width of wing disc.

Legs — Uniform whitish yellow; midtibial spur shorter than basitarsus.

Gaster — Rust coloured, dorsum flat, ventre boat shaped; ovipositor slightly exserted; subgenital plate (Fig. 13) of almost uniform width, posterior margin with a notch flanked by knobs followed by laterally directed ridges with straight anterior margin; outer plates of ovipositor (Fig. 14) narrow and truncated at apex, submarginal ridge prominent; first valvifers (Fig. 15) somewhat triangular, apical and basal angles at the same level; second valvifers long with thickened dorsal margin; third valvulae lanceolate and in a 1:3 ratio with second valvifers (Fig. 16) movably articulated. Female length: 0.95 mm.

Material studied: Holotype ♀, India, Uttar Pradesh, Bijnor, ex. *Coccus hesperidum* on *Citrus* sp., 3.5.1876 (T. Husain).

Paratypes 15 ♀♀ data same as for holotypes. with Zool. Mus. A.M.U.

Genus *Prospaltella* Ashmead

Prospalta Howard, 1894: Insect life, 7:6 (Preoccupied by *Prospalta* Walker, 1875)

Type species: (*Prospalta murtfeldtii* Howard) = *Prospaltella murtfeldtii* (Howard)

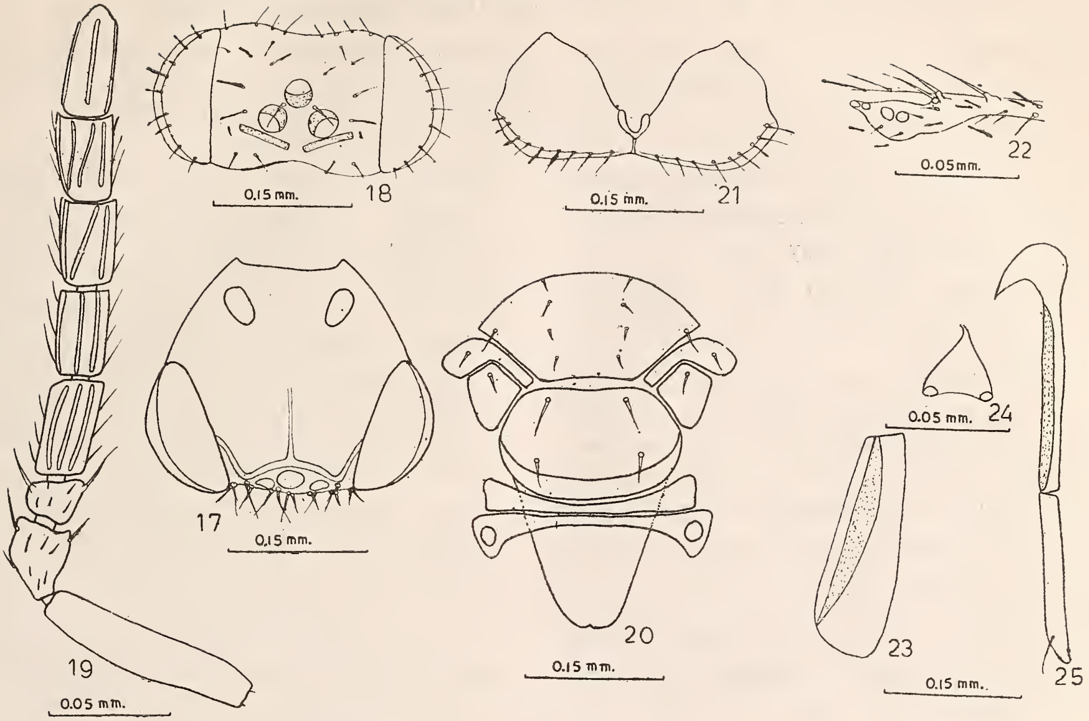
Prospaltella Ashmead, 1904: Proc. ent. Soc. Wash. 6:126

Minatomus Cockerell, 1911: Ent. News, 22: 464

Type *Minatomus peltalus* Coq.

This genus can be distinguished by the characters given by Ferriere (1965). From *Encarsia* Forster, to which it is closely related, it can be separated on the characters suggested by Agarwal (1964) namely, subgenital plate with anterior margin straight, posterior margin convex, gradually narrowing posteriorly without a median notch; outer plates of ovipositor narrow at base, broad and truncated at apex with a very narrow inflexion along dorsal margin extending upto three-fourth length of the plate.

Prospaltella clypealis Silvestri was recorded for the first time from India by Smith in 1950. Later Flanders (1969) and Shafee (1973) also recorded it. This species is redescribed to incorporate greater details .



Figs. 17-25. *Prospaltella clypealis* Silvestri.
17. Head (facial view); 18. Head (dorsal view); 19. Antenna ♀; 20. Thorax; 21. Pronotum; 22. Part of forewing venation; 23. Outer plate of ovipositor; 24. First valvifer; 25. Second and third valvulae.

Prospaltella clypealis Silvestri
(Figs. 17-25)

FEMALE

Head (Figs. 17 & 18) — Chestnut coloured with sparsely arranged setae on vertex, wider than long in facial view (0.3 : 0.23); height of malar space equal to the major axis of eyes (0.14); eyes dark, sparsely setose; vertex with two oblique dark bands just behind basal ocelli; ocelli in acute triangle, basal ocellus removed from eye rim and occipital margin by about one and a half times its diameter; mixillary palpi two segmented, labial palpi unsegmented; mandibles tridentate.

Antennae (Fig. 19) — Orange yellow; space four and a half times longer than wide (0.22 : 0.05), as long as pedicel to second funicle segment combined; pedicel slightly longer than wide (0.07 : 0.05), first funicle almost quadrate (0.05), second funicle to last club segments subequal, less than twice as long as wide (0.09 : 0.06); second funicle to club with 3, 3, 3, 4 and 3 sensoria respectively.

Thorax (Fig. 20) — Orange yellow, parapsides and metanotum slightly dark; pronotum (Fig. 21) with straight posterior margin with 18 setae, anterior margin notched in middle, notch flanked by ridges; scutum with 1+4+4+1 setae, scutellum with 2+2 setae; parapsides with a single seta each and axillae somewhat rectangular with only one seta; mesopostphragma with a notch at apex.

Fore wings — Hyaline less than three times as long as wide (0.65 : 0.25); costal cell narrow; speculum bounded by two rows of setae; submarginal, marginal and stigmal in a ratio: 3 : 2.3 : 1 respectively; postmarginal absent; submarginal with two and marginal with nine setae; marginal fringe very short.

Hind wings — Hyaline, about seven times as long as wide, marginal fringe long, longer than wing width.

Legs — Coxae and femora except apex light brown; apex of femora, tibiae and tarsi light yellow; mid tibial spur shorter than basitarsus.

Gaster — Chestnut coloured; subgenital plate with anterior margin straight, posterior margin convex, gradually narrowing posteriorly, without a median notch; outer plates of ovipositor (fig. 23) narrow at base, broad and truncated at apex with a very narrow inflexion along dorsal margin extending upto three-fourth length of the plate; first valvifers (Fig. 24) triangular with basal and apical angles at the same level; second valvifers long with thickened dorsal margin, third valvulae very long, and about half the length of second valvifers, movably articulated. (Fig. 25).

Female Length: 0.91 mm.

Material studied — 3 ♀♀ India, Uttar Pradesh, Aligarh, ex. *Aleyrodes* sp. on *Caesalpinia pulcherrima* L. 15.3.1977 (T. Husain) with Zool. Mus. A.M.U.

Comments — In all 10 species have so far been recorded from India — *P. breviclavata* Shafee; *P. flava* Shafee; *P. indica* Shafee; *P. opulenta* Silvestri; *P. clypealis* Silvestri; *P. citri* Agarwal; *P. smithi* Silvestri; *P. divergens* Silvestri; *P. pseudococci* Agarwal and *P. udaipuriensis* Shafee. Shafee (1973) has presented a very good key to the identification of Indian species.

ACKNOWLEDGEMENTS

We are grateful to the Head, Department of Zoology for providing necessary facilities.

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A NEW SPECIES OF *SCHEFFLERA* J. R. & G. FORST. (ARALIACEAE) FROM KERALA STATE, INDIA[1]

K. Ramamurthy and R. Rajan[2]

(*With seven text-figures*)

Schefflera chandrasekharanii sp. nov.

Schefflera bourdilloni Gamble affinis, sed differt imprimis: foliolis 1 - 2, magnioribus, obovatis, undulato-crenatis, apiculatis, basibus contractis pariter vel impariter; cicatricibus foliorum delapsorum prominentibus; floribus a paniculis amplis terminalibus umbellatis; pedunculis et pedicellis tomentosis stellate; staminibus petalis longioribus; filamentis incurvatis; staminodiis absentibus.

Holotypus *Ramamurthy* 66388 (CAL) et isotypi *Ramamurthy* 66388 (MH - num. acc. 109030 to 109032) lecti a sylva densa sempervirens secus via Munnar-Kumili, Idukki District in Ditione Kerala ad altit. 2000 m ca., die 26-3-1980.

Schefflera chandrasekharanii sp. nov.

Allied to *S. bourdillonii* Gamble, but differs chiefly in: leaflets 1-2, larger, obovate, wavy-crenate, apiculate at apex, tapering into an equal or unequal base; scars of the fallen leaves prominent. Flowers in large terminal umbellate panicles; peduncles and pedicels stellately tomentose; stamens longer than petals, filaments incurved; staminodes absent.

Small trees; branchlets terete, lenticellate, pale shiny, bark papery when dry, scars of the fallen leaves prominent. Leaves alternate, at the ends of branchlets, digitately 1-2-foliolate; petioles 0.5 - 1.5 cm long, terete with swollen sheathing base, glabrous. Leaflets 5 - 10 x 3 - 4 cm, obovate, coriaceous, wavy-crenatus, apiculate at apex, tapering equally or unequally at base; nerves reticulate, conspicuously distinct, curved and united at margins on both sides, lower more distinct; petiolules 0.5-1.5 cm long, terete. Flowers bisexual, in terminal umbellate-panicles; each umbel 10-15-flowered; peduncles up to 2 cm long; pedicels 1 - 2 mm long, stellately white-tomentose. Calyx *c.* 1 mm long, cup shaped, not lobed, adnate to ovary. Petals 5, each *c* 1 mm long, ovate, acuminate, inflexed, glabrous, deciduously calypterate. Stamens 5, alternating with the petals, inserted round the epigynous disc; filaments *c.* 2 mm long, incurved; anthers oblong, dorsifixed, dehiscing longitudinally; staminodes absent. Ovary inferior, 5-loculed, one ovule in each locule; style short, connate. Fruits not seen.

Holotype *Ramamurthy* 66388, (CAL) and isotypes *Ramamurthy* 66388, (MH-Acc. no. 109030 to 109032) were collected in dense evergreen forest along Munnar-Kumili Road, Idukki District, Kerala State, India at an altitude of about 2000 m on 26-3-1980.

The specific name is given in honour of Dr. N. Chandrasekaran Nair, D.Sc., Joint Director, Botanical Survey of India, Southern Circle, Coimbatore (MH) for his valuable contribution to Indian Botany.

ACKNOWLEDGEMENTS

We wish to express our thanks to the Director, Royal Botanic Gardens, Kew, England for the kind help rendered in connection

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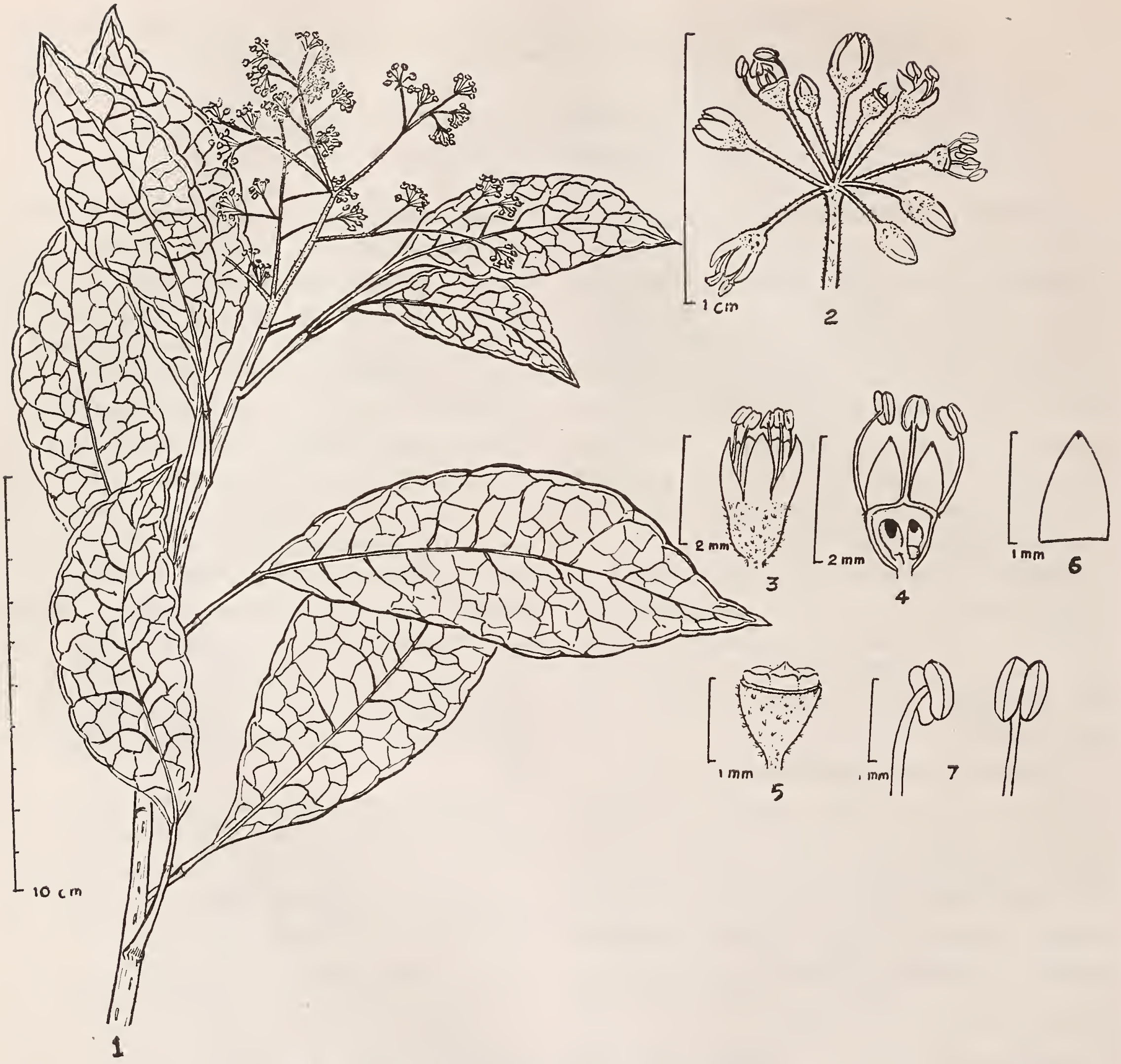
[1] Accepted September 1981.

[2] Botanical Survey of India, Coimbatore, 641 003.



Figs. 1-7. *Schefflera chandrasekharanii* sp. nov.
1. Portion of a branch; 2. Inflorescence; 3. Flower; 4. Flower L.S.; 5. Calyx; 6. Petal; 7. Stamens.

with the comparison of the materials at Kew Herbarium and for his valuable comments. Our thanks are also due to Dr. V. J. Nair for latin diagnosis, Dr. A. N. Henry for his helpful suggestions and to the Director, Joint Directors of CAL and MH of the Botanical Survey of India for their constant encouragement during this investigation.

A NEW SPECIES OF *ERIOCAULON* L. (ERIOCAULACEAE) FROM SOUTH INDIA[1]

M. Chandrabose and V. Chandrasekaran[2]

(*With eighteen text-figures*)

Eriocaulon nairii sp. nov.

Affinis ad *Eriocaulon longicuspis* Hook. f., tamen differt caulis ad 30 cm longis; pedunculis 1-3, 5-costatis; vaginis foliis brevioribus; duabus segmentis calycis flores masculis connatis, altero vero libero; sepalis flores foemineis late obovatis; seminibus cum striis horizontalibus.

Holotypus *Chandrabose* 65821 (CAL) et isotypi *Chandrabose* 65821 (MH. Acc. No. 108772, 108773, 108774, 108775, 108776, 108777, 108778) lecti apud Konalar, Anamalai, Dist. Coimbatore in statu Tamil Nadu die 16-2-1980.

Eriocaulon nairii sp. nov.

Allied to *Eriocaulon longicuspis* Hook. f. but differs in having stems elongate up to 30 cm long; peduncles 1-3, 5-ribbed, sheaths shorter than the leaves; two calyx segments of male flowers connate and the other one free; sepals of female flowers broadly obovate; and seeds with horizontal striations.

Herbs up to 30 cm tall; stems 10-30 cm long, densely covered with leafy sheaths, branched at apex. *Leaves* 2-5 x 0.4-1 cm, many, dense, in spirals, along the upper part of the stems, lanceolate or ensiform, glabrous except at sheathing base, acute or acuminate at apex, 18-25-nerved. *Peduncles* 1-3, 10-18 cm long, 5-ribbed, glabrous; sheaths up to 5 cm long, oblique at the mouth, glabrous. *Heads* 1-1.3 x 0.6-0.8 cm, depressed globose, androgynous; involucral bracts ± 4 x 2 mm, black, obovate, concave, rounded at apex, erose when old, glabrous; receptacle ovoid, plano-convex, villous with long hairs. *Male flowers*: Calyx segments 3, one free ± 2 x 1.2 mm, the other two connate into a lobed sheath ± 2 x 1.7 mm, obovate, subobtuse or subacute, serrulate at apex, papillose hairy near the tip. Corolla tube ± 1 mm long, obconical, glabrous; petals 3, white, unequal, one larger than the other two, larger petal ± 5.5 x 0.5 mm, smaller ones ± 1 x 0.3 mm, linear-oblanceolate, acute, with a black gland near the tip, densely pilose with long white hairs. Stamens 6, filaments subulate ±1.2 mm long; anthers ± 0.5 mm, black. Abortive ovary black, 3-lobed. Floral bract ± 3.5 x 1.2 mm, oblanceolate, concave, acuminate with a pointed tip, papillose without, pilose hairy from the base, 1-nerved. Pedicels ± 1.2 mm long. *Female flowers*: Sepals 3, each 1.8-2.2 x 1-1.2 mm, black, free, subequal, obovate, subobtuse, pilose along the margins and at base. Petals 3, white, each 2.5-3.5 x 0.3-0.5 mm, one little longer than the other two, linear-oblanceolate, acute with a black gland near the tip, densely pilose with long white hairs. Ovary ± 0.6 x 0.5 mm, yellow, suborbicular, 3-lobed, glabrous, 3-loculed, 1 ovule in each locule; style 0.5-0.7 mm long, filiform, 3-fid, stylar branches 1.5-1.8 mm long. Floral bract ± 4.5 x 2.5 mm, orbicular-obovate, concave, acuminate with a pointed tip, serrulate at apex, sparsely hairy without. Pedicels ± 0.7 mm long. *Capsules* ± 0.7 x 1.1 mm, depressed globose, 3-lobed, glabrous, 3-seeded; seeds ± 0.6 x 0.5 mm, yellow, ovoid, obscurely striate. (Figs. 1-18).

The holotype *Chandrabose* 65821 (CAL)

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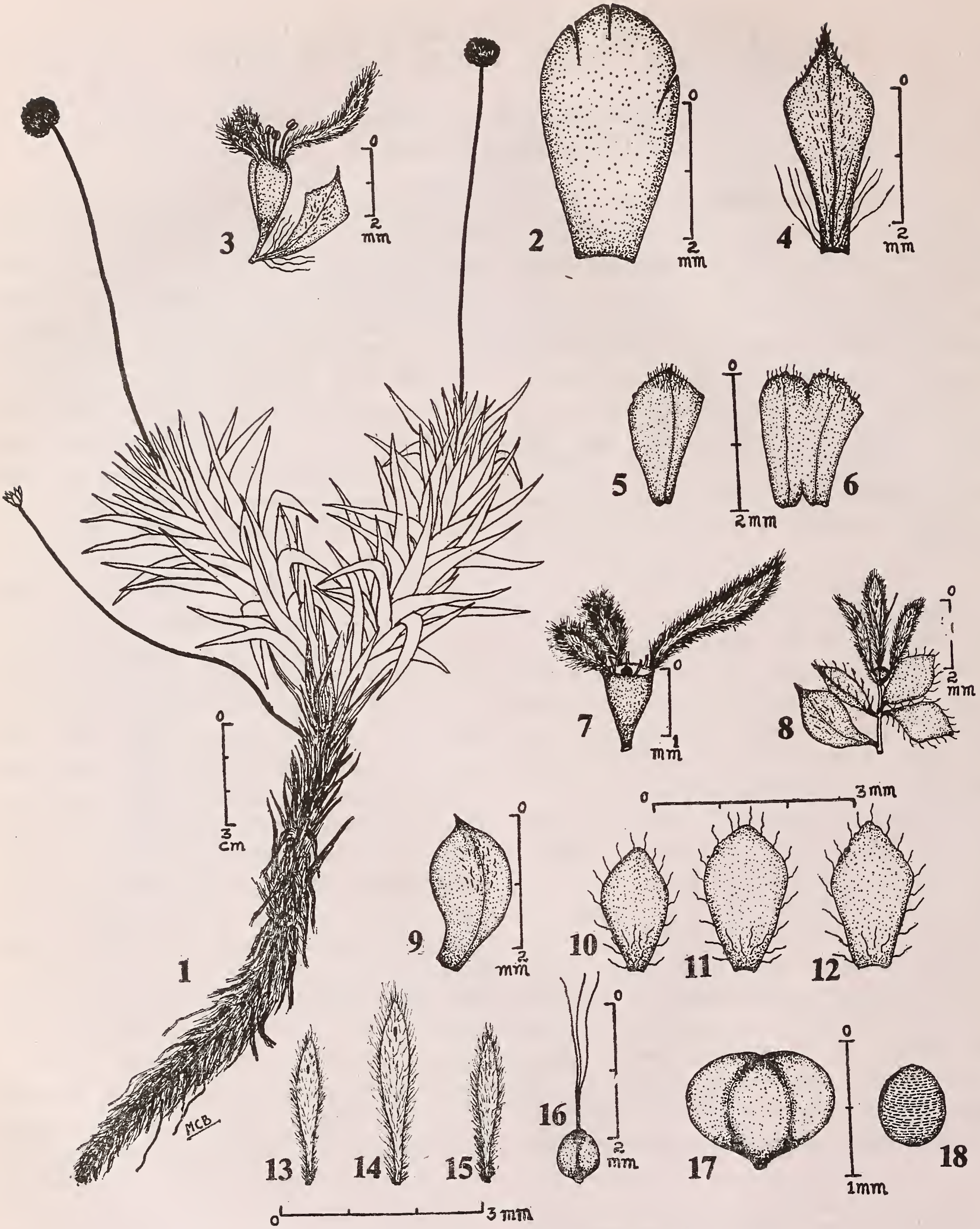
[1] Accepted August 1981.

[2] Botanical Survey of India, Coimbatore-641 003.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Figs. 1-18. *Eriocaulon nairii* sp. nov.
1. Plant; 2. Involucral Bract; 3. Male flower; 4. Floral bract of male flower; 5 & 6. Calyx segments of male flower; 7. Sepals & stamens of male flower removed showing the corolla; 8. Female flower; 9. Floral bract of female flower; 10-12. Sepals of female flower; 13-15. Petals of female flower; 16. Pistil; 17. Capsule; 18. Seed.

and isotypes *Chandrabose* 65821 (MH. Acc. No. 108772, 108773, 108774, 108775, 108776, 108777, 108778) were collected in Konalar, Anamalai, Coimbatore District, Tamil Nadu on 16-2-1980.

This species grows in tufts on grassy slopes especially in wet places at an altitude of about 1900 m. This species is named in honour of Dr. N. Chandrasekharan Nair, Joint Director, Botanical Survey of India, Coimbatore for his contributions to the taxonomy of Indian Plants.

ACKNOWLEDGEMENT

Our grateful thanks are due to Rev. Fr. K. M. Mathew, S.J., Rapinat Herbarium., St. Joseph's College, Tiruchirapalli-2 for the latin translation.

A REVISION OF THE GENUS *CALLITRICHE* L. IN THE NORTH WESTERN HIMALAYAS[1]

A. MAJEED KAK[2] AND G. N. JAVEID[3]

(*With two text-figures*)

The genus *Callitriche* L., (Callitrichaceae) with 25 species (Airy Shaw 1966), is distributed throughout the temperate and warmer countries of the world. Hooker (1878) reported only two species from the Indian subcontinent and subsequent authors did not add to this number. Later one species was recorded from Ladakh (Kak & Javeid 1976). In the present communication, besides a detailed account of three species (*C. stagnalis* Scop, *C. palustris* L. and *C. obtusangula* Le Gall), another species (*C. truncata* Guss.) is reported for the first time and a new species (*C. fehmedianii* sp. nov.) is added.

The species of *Callitriche* L. are biennial or perennial aquatic plants. Certain polymorphic species exhibit different phenotypes in water and drier sandy soils. In the terrestrial forms which are normally submerged, the modifications are primarily quantitative like shortening of the internodes, a reduction in the size of the leaves and a decrease in the frequency of chloroplast in the epidermal cells. Fasset (1951) described the bewildering polymorphism of many species with as many as few distinct individuals in *C. heterophylla* and drew attention to the occasionally very close morphological similarities of ecological forms which really belong to different species.

Extensive populations of *Callitriche* L. are gradually spreading like a weed within the Kashmir valley though they have not yet presented any serious problem. They block small streams and irrigating channels, reducing the flow of water, eventually causing flooding. They also infest ponds and lakes thus reducing the recreational amenities. The rapid spread of the species can be controlled by Sodium arsenite in the dosage of 2.5 ppm, which is not expensive and simple to apply (Hooker and Cook 1957).

Callitriche L. Sp. Pl. 969 (1753).

A group of highly polymorphic species owing to the leaf shape, whether they are submerged or floating and also dependant upon

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the depth and the rate of movement of the water, thus the key based on the leaf shape is not dependable; a key based on the fruit characters is more reliable which again can not be used because of the sterility of those species which particularly grow in deep water.

KEY TO SPECIES OF *Callitriche*

1. Plants free floating, rarely submerged
    2. Plants 12-45 cm long; leaves dimorphic, upper ones spatulate, 1.2-1.5 cm × 4 mm, 3 nerved, lower ones linear, 1.5-2 × 1-1.5 mm; style erect. Fruits 1 × 1.2 mm........*C. palustris*
    2. Plants 6-10 cm long, all leaves of one kind, linear or lanceolate, auricled, obtuse, slightly notched; single veined; style divergent. Fruit 1-1.5 × 0.6—1 mm .... *C. truncata*
1. Plants totally submerged; sometimes slightly touching the surface
    3. Leaves homophyllous; flowers unisexual separately borne in opposite axils on the same node
        4. Plants 10-20 cm long, leaves linear or linear lanceolate ....*C. fehmedianii*
        4. Plants 40-49 cm high; leaves spatulate ....*C. stagnalis*
    3. Leaves heterophyllous. Flowers bisexual; 2 perfect flowers in opposite axils on the same node ....*C. obtusangula*

Callitriche palustris L. Sp. Pl. 969 (1753); Stewart, Fl. W. Pak. 459 (1972). *C. verna* L. Fl. Suec. ed. 2, 4. (1755); Clarke, Fl. Brit. Ind. 2.434 (1879). *C. palustris* var. *verna* Fenley ex Jepson, Fl. Calif. 2.435 (1936).

Free floating rarely submerged herbs growing in slow moving waters; roots arising from the base or from lower few nodes, 6-8 cm long; stems cylindrical, weak, 12-45 cm long, green, translucent; nodes thick; internodes 1.5-2.3 cm long, smooth; leaves opposite, sessile, smooth; submerged ones linear 1.5-2.5 cm long, 1-1.5 mm broad; 3 veined. Flowers axillary, sessile, unisexual, translucent, 1 mm long; stamens 1-1.2 mm long; filaments cylindrical, white; anthers bilobed, 0.5-0.7 mm broad, exerted, brown; ovary sessile, 0.3-0.5 mm long, green, 4 angled, 4 lobed; style 2, persistent, equal, 1.5-2 mm long, exerted, white; stigma linear, brownish. Fruits globular, 1 mm long, 1.2 mm broad deeply grooved at base, margins white, transparent, notched at apex. Flowers and fruits: June-July.

Gulmarg: AMK 3255; Nishat: AMK 2049; Harwan: AMK 1138; Shalimar: AMK 3383; Javeid, 783 (HUK). Gulmarg; Naqshi, 1025 (HUK).

Type locality: Europe.

Distribution: Eurasia; California: N. America.

Callitriche stagnalis Scop. Fl. Carn. ed. 2, 2; 251 (1772); Clarke, Fl. Brit. Ind. 2; 434 (1878); Subramanyam, Aq. Ang. 18 (1962); Prain, Bengal Pl. 2, 965 (1963); Gamble, Fl. Madras 1.322 (1967); Stewart, 1. c. 457.

Submerged herbs, 20-49 cm long with roots arising at the base or along upper few nodes; stems cylindrical, green; nodes thick; internodes 1-2 cm long, branched or unbranched; submerged leaves opposite, sessile, spatulate, greenish yellow, entire, 1 nerved from base; upper leaves floating, spatulate, arranged in rosettes 1 cm × 4 mm, entire, 1 nerved at base, smooth, green. Flowers unisexual, axillary, sessile, surrounded by 2 spongy navicular bracts 1 mm long; stamen 0.7-5 mm long; filaments cylindrical, 0.4 mm long, flat, yellowish-green; anthers 0.5-0.7 mm broad; ovary tetralocular, deeply furrowed, subglobose 1-1.2 mm long, 1 mm broad, quadriangular; style 2, erect, linear, persistent, 1-3 mm long; stigma brown. Fruits 4, 2-4.4 mm long, coriaceous. Seeds 4, bean shaped, 1-1.2 mm long, 0.5-0.7 mm broad.

Flowers and fruits: June-August.

Gulmarg: AMK 602, 603, 3254; Gurcharan Singh 13 (HUK).

Distribution: Europe, N. Asia; Tropical Africa; Malaya; Australia, New Zealand.

Callitriche obtusangula Le Gall, Fl. Morbihan. 202 (1852) & Hegelm. Bot. Ver Braden. 10:114 (1868); Clapham *et al.* Fl. Brit. Isles, 488 (1862); Walters in Tutin *et al.* Fl. Europe, 3:125 (1972).

Submerged aquatic herbs, 9-15 cm long; roots 2-9 cm long, roots arising frm base and upper nodes; stems cylindrical rarely compressed, smooth, nodes thick; internodes 3-5 cm long, yellowish green; leaves 10-13 × 4-5 mm, spatulate or circular, narrowing downwards abruptly, entire, 3-7 nerved, green; upper ones arranged on well marked rosettes; lower ones linear. Flowers small, axillary; bracts 2, hyaline, navicular, 0.9-1.1 × 1 mm, persistent; stamen one, exerted, 3 mm long; filament hyaline, slightly flat at base, tapering upwards; anthers brown, reniform, basifixed, 0,7-0.8 mm broad; ovary 4 mm long, tetrangular deeply furrowed; styles 2, erect, hyaline, persistent, 3 mm long; stigma linear, brownish, Fruits sessile 1.2 × 1 mm, with 2 central furrows, apically notched, dark green to dirty brown, pitted, edges convex.

Flowers and fruits: July-August.

Menamarg (Zanskar), AMK 901, 337; Gulmarg, AMK 819, 448a.

Distribution: France, Belgium, Germany, Italy, N. Africa, Kashmir.

Callitriche truncata Guss. Pl. Rar. 4, tab 3, (1826); Boiss Fl. Or. 2,756 (1852); Butcher Illus. Brit. Fl. 1:811 (1961).

Short herbaceous annuals, submerged or floating; roots many arising from the basal nodes ;stems cylindrical, glabrous, translucent with longitudinal ridges 6-10 cm long; nodes thick; internodes 5-8 mm long; leaves homophyllous, linear or lanceolate, sessile, auricled at base, obtuse or slightly notched, entire, 1 nerved, glabrous, 3-4 mm long, 1-1.3 mm broad. Flowers axillary, minute; male and female flowers in opposite axils; bracts smooth, translucent, navicular, 0.5-0.7 × 0.2 mm; male flowers represented by a single stamen, 0.3-0.5 mm long; filaments cylindrical; anthers bilobed, globular, inserted, green or dark green; female flowers enclosed by 2 transparent

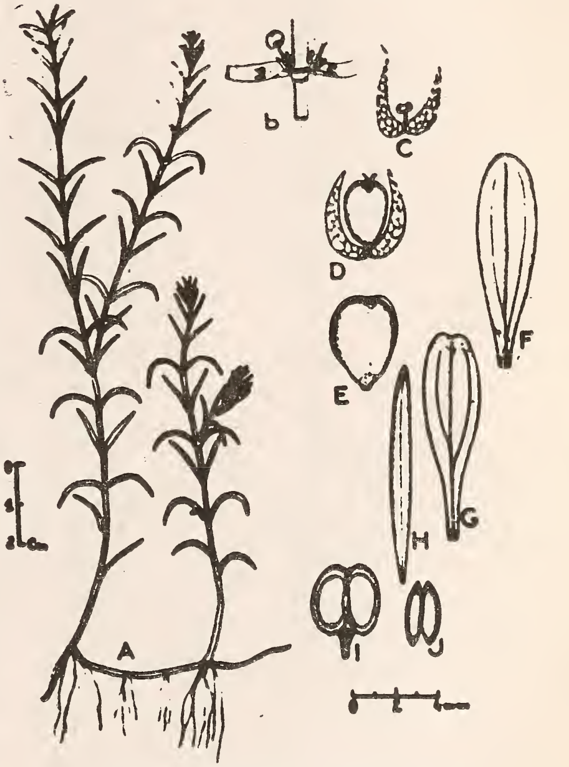
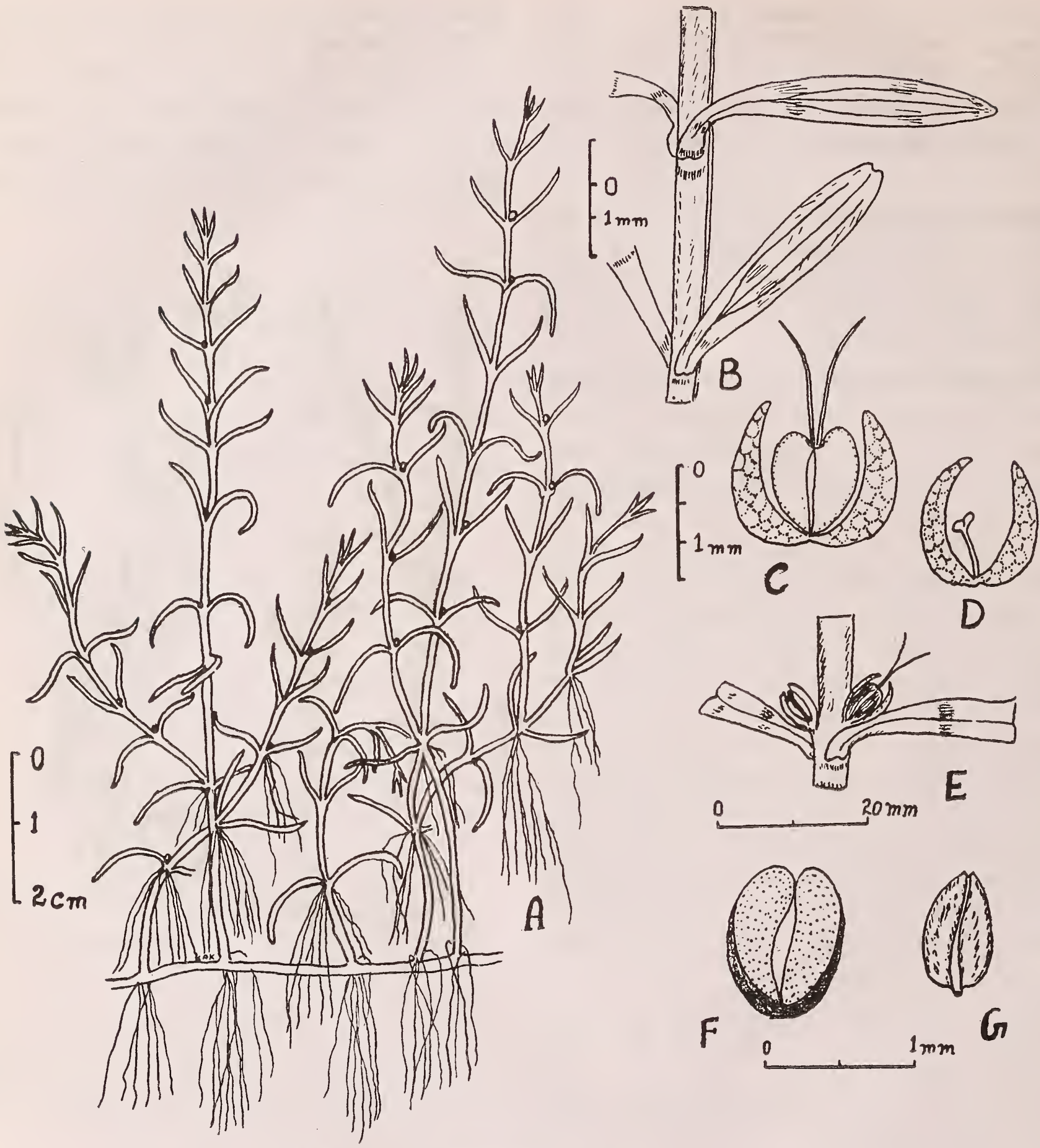


Fig. 1. *Callitriche truncata* Guss.
A. Habit; B. Arrangement of flowers in the axil; C. Staminate flower; D. Pistillate flower; E. Immature fruit; F-H. Variation in the leaves; I-J. Fruit. Front and lateral views.


0
1mm
B
0
1mm
C
D
E
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2cm
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Fig. 2. *Callitriche fehmedianii* sp. nov.
A. Habit; B. Portion of stem and leaves; C. Pistillate flowers with spongy bracts; D. Staminate flowers with a single stamen and bracts; E. Arrangement of flowers in axial of leaf; F. Fruit, front view; G. Lateral view.

bracts, 0.7-0.9 mm long, spongy, navicular, transparent with reticulate markings; ovary tetragonal 1 × 0.7 mm, furrowed; styles 2, divergent, caducous; stigma linear, brown, Fruits 1.5-1.7 × 0.6-1 mm broad, apically notched, broad at base, narrowing forward apex. Flowers and fruits: June-July. New record Tungboo (Zanskar) AMK 979.

Distribution: S. and W. Europe, Belgium, Kashmir.

Callitriche fehmedianii sp. nov.

Herba annus, infirme submersus aquaticus. Radices prostrata et numerosus radii secondarii e nodis. Caulis infirme. 10-20 cm longus, cylindricus, translucidus; ramosi vel simplices. Folia ominis similaris, rosulata linearis vel linearlis-lanceolatus, oppositus-decusatus, 0.9-1.5 mm longus, 2 mm latus, sessilis, basis auriculatus, margins integro, apices transcatus vel retusus. Floris axillaris, sessilis; floris mascula bracteae 1 mm longa; filamentae complanatus; antherae biloba. Floris feminei bracteae alba spongiosus translucidus 0.2-0.3 mm longa et 0.5 mm lata reniformis brunneus.

Holotypus: Shalimar (Srinagarensis, Kashmerienis), 1500 m super mare planus, in stagnanus vel terdus motus rivula, June 15. 1976. AMK 3823.

Paratypus: Malgam Rakh 1490 m supra mare planus, July 3.1796 AMK 3915. In herbario Universtatus Kashmeriensis (Srinagariensis) Conservatur.

Species haec affinis *C. truncatus* a qua imprimis differet.

1. Planta viridis vel flavidus, vix ultra 30 cm longa.
2. Folia obtusa, auriculatus, apices truncata vel retusa, nervus medius singularis.
3. Floris mascula et feminie obtectus a translucidus albus spongiosus bractea.

Callitriche fehmedianii sp. nov.

Annual weak submerged herbs in stagnant or slow running waters; roots prostrate, brownish with a large number of secondary roots at nodes; stems weak, 10-20 cm long, cylindrical, translucent; nodes thick internodes 1-2 cm long, smooth, branched or unbranched. Leaves of one kind, all submerged; upper ones reaching the surface, not floating neither in rosettes, linear or linear lanceolate, decussately opposite, 0.9-1.5 cm long, 2 mm broad, sessile; base auricled; single veined, margins entire, thin, apex truncate or retuse. Flowers axillary, sessile; in staminate flowers bracts 1 mm long; filaments flat; anthers bilobed, brown; pistillate flowers covered by spongy, translucent bracts, 0.2-0.3 mm long 1-1.4 mm broad with deep apical notch, lobes easily separable. Seed 0.1 × 0.5 mm broad, reniform, brown.

Flowers and fruits: June-July.

Holotype: Shalimar (Srinagar, Kashmir) 1500 m in the marshes June 15, 1976. AMK 3823.

Paratype: AMK 3915, Malgam Rakh (Srinagar, Kashmir) 1490 m above sea level along the margins of marshy and paludal area, July 3, 1976. The specimens have been deposited in the Herbarium, University of Kashmir.

The species is close to *C. truncata* but differs from it in the following characters:

1. Plants green or yellowish green, hardly 25-30 cm long.
2. Leaves obtuse, auricled, apex truncate or retuse, single veined to start with dividing in the centre of the blade giving rise two conspicuous lateral veins.
3. Both male and female flowers enclosed by white spongy bracts.

ACKNOWLEDGEMENTS

Financial assistance from the UGC to the senior author is gratefully acknowledged. We are also thankful to the Director, Royal Botanical Garden, Kew for critical examination of the material.

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TWO NEW AQUATIC PLANT SPECIES FROM KASHMIR HIMALAYAS[1]

A. MAJEED KAK[2] AND G. N. JAVEID[3]

(*With two text-figures*)

During the study of the aquatic and wetland plants of the north western Himalayas (Kashmir) for the last five years, we collected the following two species, which are markedly different from all other allied species so far reported from India and the world.

Scirpus dialgamensis sp. nov.

The species is allied to *Scirpus fluitans* L. but differs from it in having stems 3-5 cm long, erect, ribbed, branched and leafy at the base; bracts usually longer than the spikelets; glumes longer than nuts; nut reticulation prominent.

Scirpus dialgamensis sp. nov.

Annum herba, erecta, 3-5 cm alta, inferiobus radicantes. Culmi paucus, costatus; terminus inflorescentia acicularis, obtusa, 1-costa, basis vaginans, 2-3 mm diam. Spiculae isolitarii, ovatus, ovoideus, 5-7 × 3-7 mm, rubrobrunneus; bractea 1-2, acicularis, 10-15 mm longa. Glumae distichus, inferiora sterilis, superus navicularis, 3 × 2 mm, acuminata, 1-costa; stamina 2, filamenta postea elongata; styli aequans vel breviores quam ovaribus; stigmata bifidus, exertus. Nux ovoideus, plano-convexus, cum manifeste reticulum.

Holotypus: Dialgamensis (Anantnagensis), 1700 m super mare planus, 15.7.1976. In herbario Universtatus, Kashmirensis Conservatur, AMK 3736.

Paratypus: Anantnagensis (Kashmirensis); 1700 m, AMK 4018.

Scirpus dialgamensis sp. nov.

Diffused, erect annual 3-5 cm long, rooting at the base. Culms few, ribbed, terminating in a spike. Leaves equal or slightly shorter than spike, acicular, obtuse, 1-nerved, base sheathing, 2-3 mm dia., parallel veined. Spikelets single, ovate, ovoid, 5-7 × 3-4 mm, reddish brown; bracts 1-2, acicular, 10-15 mm long; glumes distichous lower few sterile, upper navicular, 3 × 2 mm, acuminate, 1-nerved; stamens 2, filaments elongate later; style equalling or slightly shorter than ovary; stigma bifid, exerted. Bristles and buttons totally lacking. Nuts ovoid, plano-convex, 2 × 1 mm, reticulations prominent.

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[1] Accepted September 1980.

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Near wet and swampy areas on the margins of slow moving streams.

Holotype: Dialgam, opposite to the Agricul-

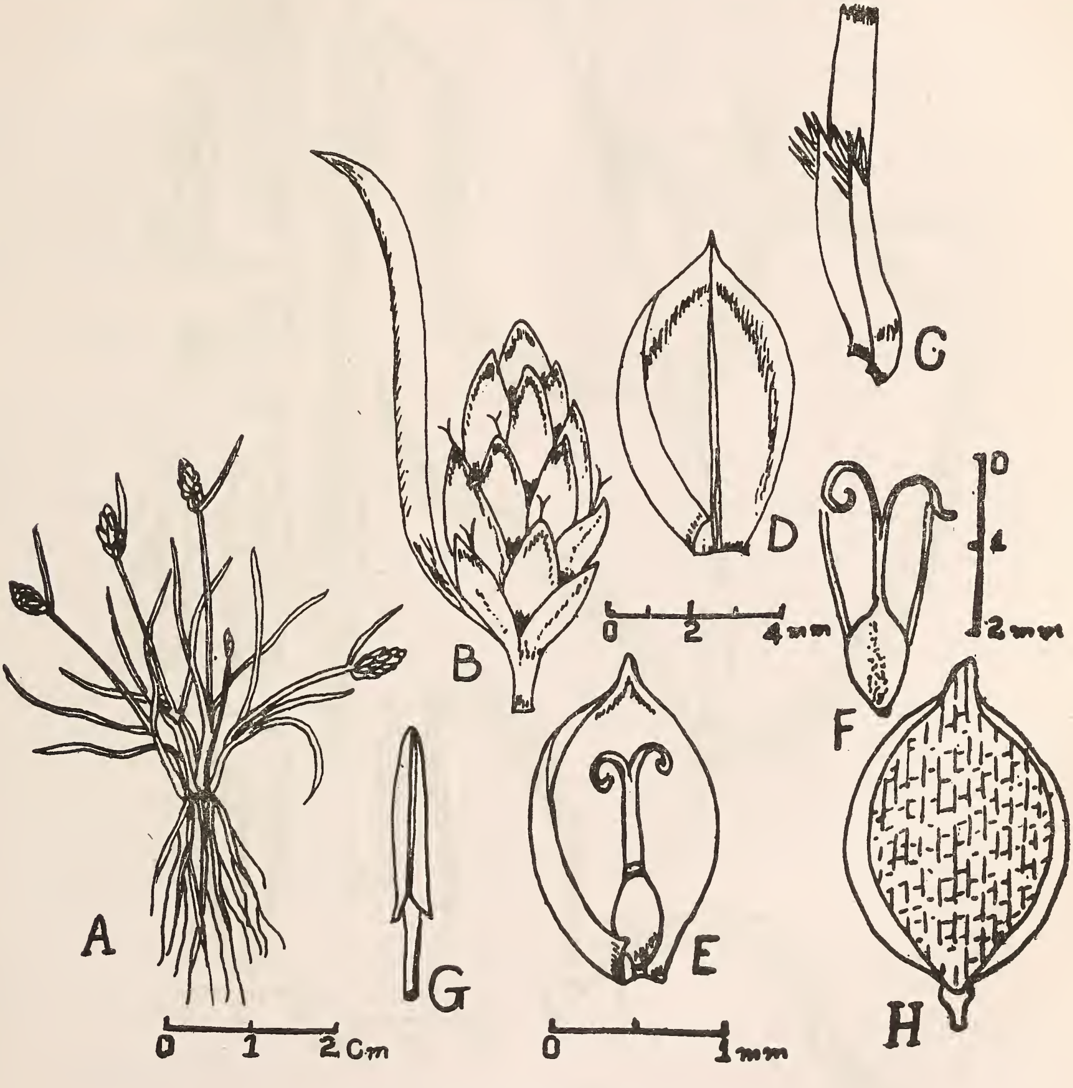
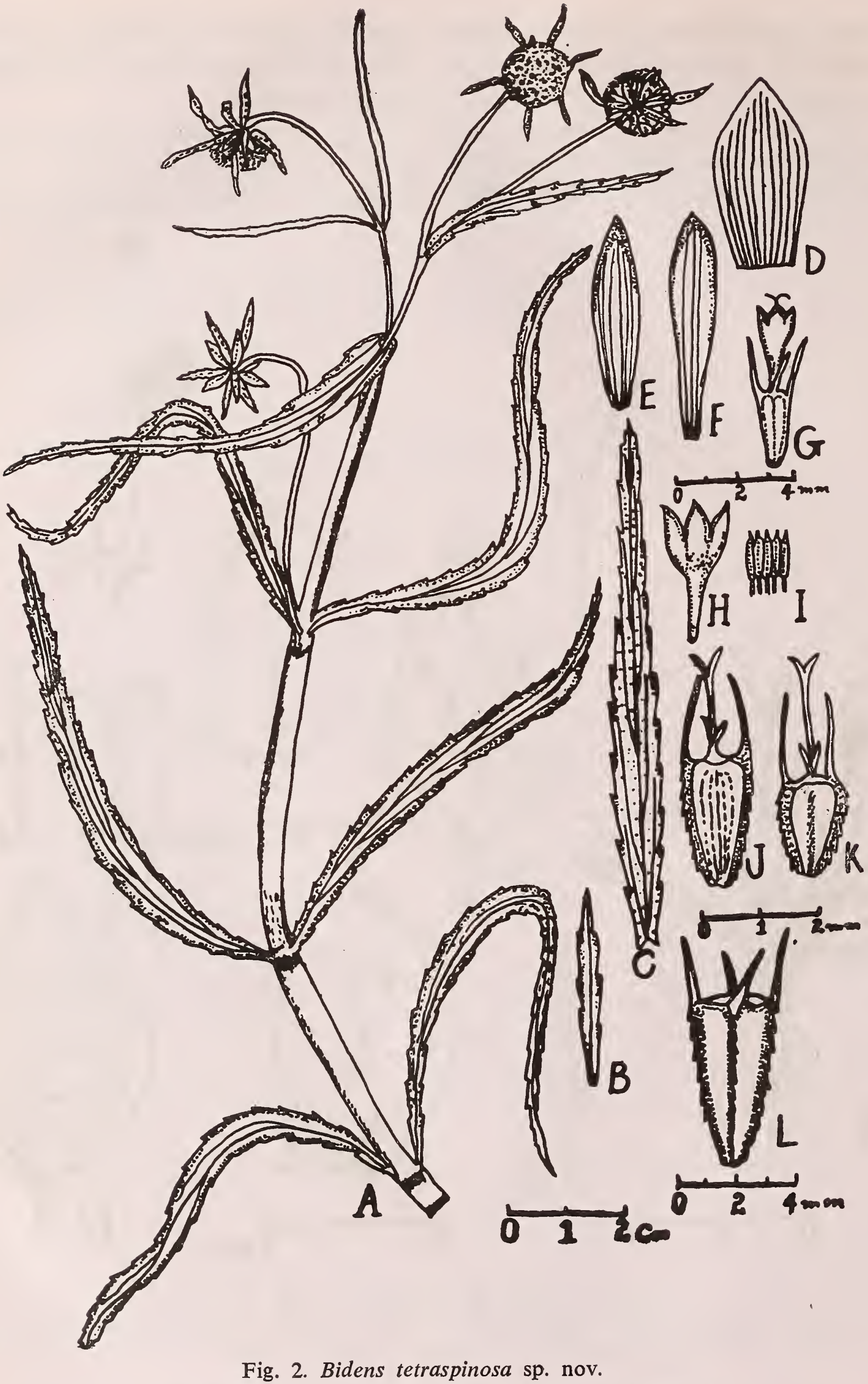


Fig. 1. *Scirpus dialgamensis* sp. nov.
A. Habit; B. Spike; C. Leaf sheath with cilia; D. Glume; E. Carpel enclosed in the glume; F. Pistil; G. Stamen; H. Mature Nut.


A
B
C
D
E
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L
0 2 4mm
0 1 2mm
0 2 4mm
0 1 2cm

Fig. 2. *Bidens tetraspinosa* sp. nov.
A. Habit; B-C. Leaves (variations); D-F. Outer and inner phylleries; G. Flower; H. Corolla tube; I. Stamen; J, K. Young achene; L. Mature achene.

ture farm (Anantnag) 1700 m, AMK 3746.
Paratype: Anantnag (Kashmir), AMK 4018,

The holotype was collected wet and marshy places under complete shade of *Salix* and *Populus* and has been deposited in the Herbarium of the University of Kashmir, Srinagar.

Bidens tetraspinosa sp. nov.

The species is close to *Bidens cernua* L. but differs from it in having linear leaves, more than 10 cm long; ovary smooth, never hispidulous. Achenes with 4 unequal spines, two shorter ones smooth, 2 longer ones with or without retrose barbs.

Bidens tetraspinosa sp. nov.

Annum paxe vel ascendene herba; radicellae basis nodus. Caulis sulcata, glabra, ramosus; folia cauline basilis integer vel ramoluisculus dentatus, basis cuneatus. Phyllaria exterior 2-6, linearia lanceolata *c.* 0.6-2 cm × 0.5-1.8 mm, lutens ad bruneus stria, obtusus membraneus; bractea receptaculas oblonga similis bractea exterior. Receptaculus planus vel tholus, foveatus, 4 mm diam. Florea 3-4 × 1.2-1.5 mm, homogamous; exterior brevior, pappi 4, in 4 angulo e quadriangule ovarium, leavis, sine serra, 2 brevis 0.5-1 mm, 2 longior, 1.5-1.8 mm longa.
Holotypus: Nagin lake (Srinagariensis) 1600 m super mare planus, 15-8-1976: AMK 624, in herbario Universtatus Kashmiriensis Conservatur.
Paratypus: Leper Hospital (Srinagariensis) 1600 m super mare planus AMK 625, 627.

Bidens tetraspinosa sp. nov.

Diffused or ascending annual herbs. Roots also arising from the lower nodes. Stems sulcate, much branched; upper leaves linear, 7-10 cm long, acute, irregularly serrate; lower leaves entire or remotely toothed, base cuneate or subsessile; outer phylleries 2-6, linear lanceolate 6 × 3 mm, yellow with brown streaks, obtuse, membraneous; receptacular bracts oblong, receptacle flat or dome shaped, pitted, 4 mm dia. Flowers homogamous, 3-4 × 1.5 mm, outer ones slightly shorter; pappus 4, on the four corners of of the quadriangular ovary, smooth without serra, 2 shorter (0.5-1 mm) and 2 longer (1.5-1.8 mm); corolla companulate, 5 fid; stamens with apical acute appendages; stigma rays shorter, linear. Achenes cunate, 3-4.2 × 1.5-2 mm. 4 angled, striate flat top, with 4 unequal smooth spines; shorter ones 1-1.2 mm; longer ones 2 mm long; margins retroserrate (sometimes serrate, rarely absent in one or two margins).
Mostly near swamps, lowland areas, and on floating islands.
Holotype: was collected in a gregarious patch on the margin of floating islands near Leper Hospital (Nagin lake) 1600 m on 15-8-1976, AMK 624; deposited in the Herbarium, University of Kashmir, Srinagar.
Paratype was also collected at various places; Suderbal—Leper Hospital side (Srinagar) 1600 m, AMK 625, 627.

The same species was subsequently collected in two other localities in Srinagar District—Shalimar 1700 m, in marshy places; and Anchar lake 1600 m on floating islands.

ACKNOWLEDGEMENTS

We are deeply grateful to the Director, Royal Botanic Gardens, Kew, and to Dr. Subramanyam, for valuable suggestions on the plants and to the University Grants Commission for providing financial aid to the senior author.

REVIEWS

1. SAVING THE TIGER. By Guy Mountfort. pp. 124 (27.5 x 23 cm), with 124 Black-and-White and coloured photographs. London, 1981. Michael Joseph. Price £ 7.95 net.

Guy Mountfort is one of the founders of the World Wildlife Fund. His lifelong fascination for the tiger was given a practical outlet when he became the prime mover in the campaign to save the tiger. He enlisted the support of the Prime Minister of India for this campaign, and was largely instrumental in initiating Project Tiger in India, with a generous allocation of funds by the Government of India and very substantial assistance from the world wide fund raising campaign mounted by the World Wildlife Fund.

The book is a labour of love. Gay Mountfort traces the history, behaviour and habits of the tiger, bringing together a great deal of information which has been collected in recent years. The territory marking, the mating and breeding behaviour, the care of the young etc. are all described in the light of the latest scientific information. The conditions which may lead a tiger to attack man, whom he usually avoids, are also discussed, and it can be seen that, in India particularly, man eating by tigers is frequently a result of encroachment on its habitat, and destruction of its natural food sources, by man and his domestic animals.

The advent of firearms, and the rapid decimation of the tiger in India which followed this development, together with the fascination for shikar and collection of trophies, are briefly outlined.

A survey is given in part three, of the operations to save the tiger, the setting up of tiger sanctuaries, and the types of studies which are being undertaken in some of these, using the latest telemetry techniques.

The importance of the habitat, and the fact that saving a tiger means we are saving 25 or more square miles of a natural environment with all its potential for resource regeneration, has been touched upon. This fact needs more emphasis if the campaign is to carry conviction to the layman.

Within a small compass the book packs a great deal of information, fascinatingly written and well presented, The book would be worth the price for the photographs alone. Yet, at the present price, the book is likely to appeal only to the enthusiast, who is already 'sold' on wildlife, but is unlikely to attract the general reader. For ultimate success of the project, it is essential to involve the general reader, and it is hoped that a cheaper edition, even if it means cutting out a large number of the excellent plates, will soon be made available at a price which will make it attractive to the non-enthusiast.

A. N. D. NANAVATI

2. THE BIRDS OF OMAN. By Michael Gallagher and Martin W. Woodcock. Foreword by H. M. the Sultan. pp. 310, (21.5 x 30 cm). Plates I-XII (photos) and 1-120 of paintings by Martin W. Woodcock. 4 end-plate maps, 5 appendixes, Bibliography and Index. Quartet Books Ltd., London, 1980. Price £ 37.50.

The sultanate of Oman lies along the eastern tip and seaboard of the Arabian Peninsula at approximately the same latitude as the tip of the Kathiawar peninsula *c.* 600 miles eastward across the northern Arabian Sea. Though flanked by the great belt of arid deserts which stretches from W. Africa to China, the country itself is favourably situated: it escapes the harshness of desert conditions and, contrary to popular conception, it enjoys a comparatively cool climate with a moderate but unevenly distributed rainfall and mainly two distinct seasons — a hot summer and a cool winter, more or less as in the Indian subcontinent.

The physiography of the country is well described in an introductory chapter. Surprisingly for the outside world it is land of unexpectedly diverse ecology. In addition to rolling sand dunes and oasis cultivation, it has reed-lined creeks, grassy plains, wooded hills, high mountains, deep gorges and perennial streams. The varied physiography supports a correspondingly diverse avifauna, thus this comprehensive chapter is of great interest in providing an adequate background for the unexpecting reader. "Most of the 372 species of birds known in Oman" says the author "are of Palaearctic origin though there are no relict species as in SW Arabia. There are also endemic Arabian species and birds from India and Africa. . . ." In a useful historical account of Oman ornithology one notes that some of the pioneering work on Arabian birds in the last century has been done by names intimately connected with Indian ornithology such as W. T. Blanford, A. O. Hume and Surgeon Lieut. Col. A. S. G. Jayakar (discoverer of the Arabian Tahr in the mountains of Yemen), Col. R. Meinertzhagen, Sir Percy Cox and Dr. S. Dillon Ripley. Short sections follow on Habitats (in general), Habitats of breeding birds with the species found in each of the following: Mountains, Coastal plain, Desert, Semidesert, Wetlands. One chapter "Observing Birds" is addressed primarily to beginners which, in view of the awakening awareness among local residents of the great variety of bird life to be found in the sultanate, and the wide range of available habitats, should prove helpful to beginners and prospective beginners in bird watching. It gives useful practical tips on how and what to observe and record, the binoculars to choose, and so on; also on cameras and bird photography.

The 120 full page colour plates depict several species each, sometimes both sexes and sometimes also seasonal dimorphism. The paintings are beautifully executed and excellently reproduced. The concise descriptive captions on the facing pages aptly supplement the illustrations. The families are arranged in the modern taxonomical sequence which makes for easy comparison of related species. In addition to distinguishing characters the text gives the distribution and status of the birds within and outside the sultanate whether migrant or resident, the habitat in which it may be found, and such other relevant details. All this in fact makes the book an ideal pictorial guide to the birds of Oman. But while the large format makes for aesthetic attractiveness on the "coffee table" and allows better justice being done to the colour plates it also cripples the usefulness of the book as a field guide for the beginner and the bird watching tourist who would appreciate a handier volume that can easily be carried in the field. For the benefit of budding birdwatchers in Oman and neighbouring Arab countries it is to be hoped that the publication of a standard fieldguide-sized version of the book will be considered by the authors and publisher. The text is clear and concise and refreshingly free from obvious typographical errors except that on p. 82 *Marmoretta* should of course read *Marmaronetta*!

SALIM ALI

3. PERMA-CULTURE ONE: A PERENNIAL AGRICULTURE FOR HUMAN SETTLEMENTS. By Bill Mollison & David Holmgren. pp. vii + 128 (27.5 x 21 cm) with many illustrations. Australia, 1978. Corgi Books. Price $ 4.95 (Australia), $ 5.50 (New Zealand).

PERMA-CULTURE TWO: PRACTICAL DESIGN FOR TOWN AND COUNTRY IN PERMANENT AGRICULTURE. By Bill Mollison. pp. ix + 150 (27.5 x 21 cm) with many illustrations. Australia, 1979. Tagari Books. Price $ 8.00 (Australia), $ 8.50 (New Zealand).

Several decades ago Karl Gayer and Franz Heske, two eminent German foresters, advocated the 'Back to Nature' movement emphasising the importance of biological laws to sustain the productivity of soil. Today Masanobu Fukuoka of Japan (The One-Straw Revolution: An Introduction to Natural Farming; Rodale Press 1978) and Bill Mollison of Australia are among the foremost gurus who successfully demonstrate through their practice the perennial philosophy of Permaculture — a system of conservation, the wise use of natural plant and animal resources, capable of optimum, sustainable production.

Bill Mollison's Permaculture One and Permaculture Two are of fundamental importance to agriculture and forestry. They explain how permacultural systems can confer benefits to urban areas as well. After a single twenty-minute radio talk from Melbourne on Permaculture on May 24, 1977 Bill Mollison received 3500 letters from council engineers, horticulturists, doctors, churchmen and housewives. Postmen volunteered to carry seed and some people announced that they were commencing a permaculture from that date. Extracts from the two books are reproduced below to convey the gist of Mollison's ideas.

Yields

The productivity of agriculture is usually assessed by the yield per unit area. Yields/unit area from any particular species are likely to be lower in a permaculture ecosystem than in monoculture. However, the sum of yields from a permaculture will be greater, simply because a single-species system can never use all available energy and nutrients. For example, a multistorey plant system uses all available light for photosynthesis. Species of trees, as Kern points out, have different-shaped root systems tapping different water and nutrient sources. Therefore, in mixed forest stands there is more complete use of resources than in single-species stands. A plankton-eating fish in no way competes directly with an algal browser in a pond, since it cannot use the algal food. Poultry and guinea fowl can range on the same area since the former are primarily seed-eaters and the latter grazers. Thus a complex permaculture can maximise use of all available resources and so increase total yield.

The Edge Effect

The "edge effect" is an important factor in permaculture. It is recognised by ecologists that the interface between two ecosystems represents a third, more complex system which combines both. At interfaces, species from both systems can exist and the edge also supports its own species in many cases. Gross photosynthetic production is higher at interfaces. For example, the complex systems of land/ocean interfaces — such as estuaries and coral reefs — show the highest production per unit area of any of the major systems. Forest/pasture interfaces show greater complexity than either system in both "producers" (plants) and "consumers" (animals). It seems that the Tasmanian aborigines burnt forest to maintain a large interface of forest/plain, since these transitional areas provided a great variety and amount of food. Animals are found in greater number on edges, for example.

Pest Control in Permaculture

Prevention can play a major role in pest control. Complex ecosystems tend to be more stable than simple ones and less prone to unchecked rises in particular populations. It is generally accepted that monoculture leads to dramatic increases in pest populations, these benefiting from the presence of the crop while the new environment may be unfavourable to their predators — plague is the result. If we have a system with diverse plant and animal species, habitats and micro-climate, the chance of a bad pest situation arising is reduced. This is especially true of arthropod pests.

Ducks, hens and other domestic birds are generalised feeders, keeping the areas in which they range fairly free of many pests, particularly slugs and snails.

Permaculture in Cities and Towns

All cities have unused open land; roadsides, corners, lawns, areas front and back of houses, tubs, verandahs, concrete roofs, balconies, north-facing glass walls and windows. Many suburbs are well planted but if one deliberately selected a group of plants useless for man, these are what we see in the city. It is as though a useful tree, shrub, vine or herb is shameful; as though it is a sign of status to grow only unusable plants; a form of conspicuous wealth. The city could, at little expense, provide a great deal of its food and in so doing, use much of its own wastes as mulch and compost. But perhaps the most valuable product of a city devoted to permaculture would be peace of mind; a paranoia pervades cities and it is a product of helplessness in the face of approaching energy shortages and uncertain futures.

By developing private and public permacultures, people could see a food resource allied to the shelter the city over-provides and involve themselves in meaningful tasks, aiding their own (and others) survival.

The sane ethic is to use all land close to settlement as permaculture; any botanic garden demonstrates the possible rich variety available to city agriculture and could also provide seed, advice and expertise. Similarly, councils and public authorities have small armies of men tending non-productive systems. It is only a matter of public persuasion and responsible decision to direct these activities to useful species, in a multi-dimensional and many faceted permaculture. Nothing of beauty or variety need be sacrificed and a year or two of such effort would ensure a long-term resource within the city and at its boundaries, where transport and processing costs are least.

On Permaculture and Community

Permaculture both conserves and generates the fuel energies of transport systems, and would enable any community to exist comfortably on very restricted land areas. Supplemented with the appropriate and available technologies of methane and alcohol fuels, dry distillation processes, and wind, wave, water or solar energies, it would provide the basis of a sustainable and regionalised society. Combined with community cooperation, permaculture promises freedom from many of the ills that plague us, and accepts all the organic wastes of the community it serves.

Permaculture must be practised widely in India. It is labour-intensive and will create employment for many to increase production of essential materials both in rural and urban areas. Every discipline, trade and skill would be used in the planning, control and production of the system. Involvement in permaculture will provoke a philosophical and natural approach to the environment and its products, demonstrate the intrinsic values of complex systems and generate the basis of a fully integrated environmental science. It is a philosophy which would create not merely material wealth but spiritual wellbeing as well.

SHANKAR RANGANATHAN

MISCELLANEOUS NOTES

1. ON THE OCCURRENCE OF GENUS *CROCIDURA* (MAMMALIA: INSECTIVORA) IN PENINSULAR INDIA

I read with interest a note by Dr. Rao and Aswathanarayana (*J. Bombay nat. Hist. Soc.* 75(2): 473, 1978) in which they have recorded the occurrence of the genus *Crocidura* in peninsular India (Mysore). I would like to point out that this is not the first record of the genus from the area as it has already been recorded by me on the basis of a skull found in the pellets of an owl in Jabalpur District of Madhya Pradesh (*Cheetal,* 51(1): 46-47, 1972). I appreciate authentic identification of the species and further distributional information.

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BAGHDAD UNIVERSITY,
BAGHDAD, IRAQ,
May 14, 1981.

H. KHAJURIA

2. NOTES ON THE INDIAN PIGMY PIPISTRELLE (*PIPISTRELLUS MIMUS* WROUGHTON) IN THE THAR DESERT

The Indian Pigmy Pipistrelle (*Pipistrellus mimus*) is the most common and widely distributed bat in the Indian desert, in wilderness areas as well as villages and towns. It lives singly or in a small group in buildings, crevices of rocks and hollows of trees. The pipistrelle lives in crevices of walls and is common in the Rajasthan desert (Prakash 1960) it may also live under the bark of Banyan tree. The breeding season is March to May (Brosset 1962). I observed this bat from April 1977 to September 1979.

It roosted in hollows of *Prosopis cineraria, Salvadora* spp. and *Tecomella undulata* trees as well as fissures and crevices of rocks. In villages and towns it roosts in crevices and in walls, holes around windows, or similar cracks in constructions were found to be the most favoured roost sites for this bat in urban areas. Single to groups upto five bats were observed roosting in suitable roost spaces. They left the roost site very early at dusk, about 10 minutes after sunset where as other bats leave after about 30 minutes. Flies in the vicinity of the roost for a few minutes before proceeding to the usual hunting ground which may be 750 metres or even 5 kms away from the roost site.

The returning timing was found to be 25 to 15 minutes before sunrise and it makes several rounds for a few minutes near its roost crevice before entering it for the day.

The bat is widely distributed in the Indian desert except in treeless areas. It is common in villages and towns because food (insects) availability and roosting facilities. Similarly populations were higher in *Salvadora, Prosopis juliflora, P. cineraria* dominant jungles.

By the analysis of its droppings (wings and cuticles of eaten insects) it appears that it largely takes Diptera, Lepidoptera, termites, Hymnoptera and small Coleoptera insects. It hunts insects over *Prosopis juliflora* and *Salvadora* spp., over water surfaces (tanks and rain pools), grasslands (lawns in towns) and agricultural fields etc. In towns, lamp posts of streets are its most favourite hunting grounds, it was noted that as bright lamps (mercury vapour lamps) attracts more insects, so these indirectly attract the bat more for food.

The bat flies between 4 to 10 metres above the ground for hunting insects but may dive low upto 25 cms above the ground while chasing a prey.

Hibernation: From December to February when temperature at nights is below 15° it was not observed coming out of its roost for hunting and moved deeply in to crevices to have less effect of cold, yet it was observed to be active therein, moving and scratching etc. The bat flights in light drizzles but in heavy rains ceases to fly.

Breeding: The young were observed from March to April, litter size largely, one young. A young measured head = 1.2 cms, ear = 0.6 cm, wing (patagium) = 3.0 cms, whole length 3.5 cms. The mother licks, suckles her young and occasionally wraps it with her patagium. Young wean in three months.

A very useful bat which consumes harmful insects and has finely adapted itself to be a commensal of man in urban areas enjoying roosting and feeding facilities there. As its droppings dirty house people often plug its roost crevices in houses.

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October 27, 1979.

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3. OBSERVATIONS ON A ROOST OF FREE-TAILED BAT *TADARIDA PLICATA PLICATA* (BUCHANAN) IN EAST-NIMAR

During the study of bats of East Nimar in 1976 and 1977 some data were gathered on a migratory colony of *Tadarida plicata plicata* (Buchanan). These bats which constitute a major population of molossid fauna in East Nimar from 26th May to September 16, were absent from their roosts during the rest of the year. During May to September the number of individuals in the colony varied at different times: 300, on 28th May 1976; 200, on 26th May 1977; 500, on 20th July 1977; 500, on 18th August; 200, on 1st September; Empty 10th September. The population of these bats decreased substantially daily from September, 1; and the habitat was left vacant by September 10. Although there is no migratory record nor any evidence of shift in their population in East Nimar during Autumn to the following summer, it is very likely that they migrate to other roosts during this period.

Collection localities:

Only one colony was observed in this survey. These bats have been found roosting a big room in Anand Talkies at Khandwa. The room is 40x20x35 feet in size is dimly lighted and frequently disturbed and waste materials are dumped in this room.

Tadarida plicata plicata has well defined field characters by which it can be distinguished from *Tadarida aegyptiaca*. The former has broad head, and the snout tip to tragus length is always greater than that of *Tadarida aegyptiaca*. *Tadarida plicata plicata* has six incisors in lower jaw. The patterns of fur, covering neck regions, appears to be forming a collar-like shape which gets separated from the rest of body when the head moves down-wards. There is a marked variation in the colour of its fur. This has been noticed in the two individuals of this colony. Two main types given below were mainly observed:

(1) Buff brown above and grey below.

(2) Blackish grey above and grey below.

It was noticed that this bat selects the warmer parts of the room whether on the ceiling or in a crack. The highest temperature of this room was about 40°C. The daily fluctuations may be 10°C in a day.

In the rainy season these bats were found to be present in clusters on rough surface of the walls in the highest parts of the room. The clustering and colony composition it was observed, showed no definite sequence. A pungent, musky, odour was noticed in this room on June 15th 1977, when a large number of bats arrived and both horizontal and vertical cracks of the room were packed with these bats.

The testes (7.5 x 5 mm) of males were exabdominal and scrotum was present. The average body weight of male was 17 to 19 gm, and of the female was 17 to 20 gm. The weight of testis was 100 mg.

A large number of females had a single embryo, of 7 to 10 mm length, in the right horn of uterus. This was noticed in the majority in July 1977, and were so developed that the delivery was expected in October, 1977.

In this roost bats emerged for foraging soon after sun-set and within half an hour the room becomes completely empty. They returned after one hour.

ACKNOWLEDGEMENTS

I express my indebtedness to Prof. D. R. Sharma for valuable suggestions. Thanks are also due to Department of Zoology, S. N. College, Khandwa for providing the necessary facilities, during this investigation. The financial assistance offered by the University Grants Commission, New Delhi for this research work is gratefully acknowledged.

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4. NOTES ON BARBE'S LEAF MONKEY *PRESBYTIS BARBI* BLYTH

Barbe's Leaf Monkey locally known as *Dudhi Mukho Bandor* or *Chasma Chok*, is found in all three districts of Tripura, but the species has not been included among the 18 non-human primate species recorded in different parts of the country (Mohnot 1980). Other primate species besides Barbe's leaf monkey occurring in Tripura are common tree shrew (*Tupaia glis*), Slow loris (*Nycticebus coucang*), Assamese Macaque (*Macaca assamensis*), Rhesus Macaque (*Macaca mulatta*), Pigtailed macaque (*Macaca nemestrina*), Capped langur (*Presbytis pileatus*) and Hoolock Gibbon (*Hylobates hoolock*). Practically no work has been done on the ecology of any of the species known from Tripura. Barbe's leaf monkey is probably found only in Tripura in India.

The head and body are dusky grey with pale buff sheen on the back and black erect brow. A well defined crest present. The whiskers are fairly long and partially cover the ears. The area around eyes and upper and lower lips, chalk white. Ventral fur silvery white. Fore and hind limbs are of the same colour as the body except the black hand and feet. The tail slightly paler than the body with a tuft of black-brown hairs at the tip. The area below pubic callosities light grey in male but yellowish in female. The young ones are pale in colour.

Barbe's Leaf Monkey is found in Tripura where rainfall is high and forests are tropical evergreen/tropical semi-evergreen and moist deciduous forests with Bamboo brakes. They are completely arboreal and seldom found near human habitations.

The troops consists of a dominent male with 5/6 females, subadults and young ones, which are usually born during September-October. The average troop size is 10-12, and the largest troop seen was of 22, at Paratia under Udaipur Division.

They feed mostly on leaves, flowers and fruits and were never seen on the ground. The leaf monkey was seen feeding on the following trees. Young shoots being favoured.

Mangifera sylvatica, Phyllanthus emblica, Terminalia bellerica, Hymenodictyon excelsum, Artocarpus chaplasha, Alstonia scholaris, Gmelina arborea, Dipterocarpus turbinatus, Dillenia pentagyna, Albizzia stipulata, Terminalia chebula, Bursera serrata, Amoora rohituka, Cedrela toona, Schleichera trijuga, Amoora wallichii, Bombax ceiba, Legerstroemia flos-reginea, Anthocephalus cadamba, Bauhinia spp., *Schima wallichii, Swietenia mahagoni, Erythrina suberosa.*

Though an exact census has not been conducted, it is estimated that the total population in Tripura will be around 400 and 60% of these are found in the south and west districts of Tripura.

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I am thankful to Dr. V. C. Agarwal and Dr. R. P. Mukherjee of Zoological Survey of

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REFERENCE

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5. INCIDENTAL OBSERVATIONS OF THE SPOTTED LINSANG (*PRIONODON PARDICOLOR*)

The spotted linsang is recorded from primary and secondary forests in Nepal, Assam, northern Burma, and Indo-China at elevations of 150 m (above sea level) to 1850 m (Prater 1971). Little is known of the ecology or natural history of the linsang. Breeding is thought to occur in February and possibly again in August. An individual kept in captivity in Darjeeling refused to eat fish, eggs and fruit but lived on raw meat (Prater 1971). However, two banded linsang (*P. linsang*) in captivity in Malaysia readily ate white mice, birds, fresh fish and fresh eggs but rejected fruits such as banana and papaya (Liat 1973). Stomach contents of three wild-caught banded linsang included remains of spiny-furred rats, birds and a tree lizard, indicating that the linsang hunts on and above the forest floor (Liat 1973). Indeed, of 12 banded linsang collected in Malaysia, eight were shot while moving between three and eight metres above the forest floor; the remainder were trapped on the ground (Liat 1973).

Four observations of spotted linsang in the lowland forests and grasslands (150 m a.s.l.) of Royal Chitawan National Park in southern Nepal (latitude 27°30′N; longitude 84°20′E) support this information. In one instance in late February (1975) an adult male and an adult female fell into a well and drowned. Such a close association suggests that mating activity was involved. The remaining observations indicate the animal is an opportunistic carnivore. On 17 January 1975 a linsang was driven out of dense vegetation surrounding a tiger (*Panthera tigris*) kill when domestic elephants moved through the area. The habitat was a mosaic of riverine forest and tall, dense grasses. This individual was probably an adult based on measurements given in Walker (1975: 1231). Another linsang, also judged to be an adult, was seen feeding on the carcass of a tiger kill at 1830 hr on 4 February 1975. The kill was located in an area of dense riverine forest. While the observation of 4 February was only 2 km east of that for 17 January it was unlikely that the same animal was involved because it would have had to cross a river about 150-200 m wide. The third observation occurred in mid-March (1979) in an area of sal (*Shorea robusta*) forest interspersed with dense grasses. A linsang, presumably an adult, came to the remains of a tiger kill at about 1700 hr and began feeding. This location was 2.8 km west of the 17 January observation. No other linsangs were observed at the three tiger kills, suggesting that these individuals were traveling alone.

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6. BLACKBUCK CENSUS IN POINT CALIMERE: A REJOINDER

Dr. S. S. Nair (*JBNHS* 73: 304-310, 1978), after doing a one man survey of Black-buck in the Point Calimere sanctuary in October 1974, concluded that a) only 340 animals exist in the Sanctuary in opposition to the Forest Department estimate of 1000+; b) this indicates a steep population decline, or incorrect censussing. This is used to argue that there is both a lack of proper conservation measures and that Forest Department estimates anywhere in India cannot be trusted (He appears to miss the contradiction between these two statements). He further warns that unless corrective measures are taken soon, blackbuck will become a memory of the past, without unfortunately spelling out what these corrective measures should be.

I will not stress here the obvious point that more animals need not necessarily mean better management, as the carrying capacity of the habitat could easily be exceeded. I would like, however, to point out some of the methodological flaws in Dr. Nair's census.

The technique used by the Forest Department is that of a total visual count, a tested and simple method recognised and used as a standard technique today and is known as Spatial census 2 in which a count is made of all the animals in a specified area at a specified point in time. The count is instantaneous in its properties. This technique, which is ideally suited for open habitat animals, like the blackbuck at Point Calimere calls for no special qualification, training, skill or scientific knowledge except that the enumerators should be able to age and sex the animals they see. As we are not omniscient and omnipresent, we usually employ sufficient numbers of census parties and more than one individual in each census party.

On the other hand, some of the disadvantages of the one man survey may be considered. The black-buck is not a static animal, and duplications are likely, especially since individual recognition is extremely difficult. Visibility is reduced due to the undulating terrain at Point Calimere and the evergreen thickets. Waterlogged conditions in October would also prevent any observer from moving in a straight line. At one time normally, any observer cannot command a view greater than 140° and an area of 44 Ha. is very flat country if the view is not obstructed upto 600M. In such situations any count arrived at cannot be called "Total" but in effect is a rather inefficient sampling method.

To illustrate my point Dr. Nair states that there were "no animals in plots 9, 11, 13 and 14" (his table 1). The only valid inference however is that no animals were sighted by him at the time of the survey! The counting in each plot may have taken, say, one hour projecting randomly selected one hour results to 24 hours is hardly likely to lead to accuracy in this case.

Again the total length of the census lines works out to be approximately 18 Km. where compared with from Survey of India maps (unfortunately, Nair has not indicated the scale of the map). These census lines and triangles appear efficient on paper. They are useless for census work since they are not marked on the ground. Also, because of possible duplicates in counting due to the animals moving, caution should be exercised in interpreting density, herd composition and age structure. Using Dr. Nair's own data, if the minimum herd size is multiplied by the number of herds, the total number of animals arrived at is 722+ Minimum 722 Maximum 1140 and mean 931. It is a pity that the enumerator did not take along local staff to assist him, as was done in Mr. J. C. Daniel's census in 1967. It is obvious that even a total census will result in some errors. However, Nair's sampling is vitiated by the fact that he does not give estimates of variance, or the confidence limits to be placed on his observations. In view of this, one would fail to understand why Forest Department census estimates in India as a whole should be condemned. I would like to state that a number of non-Forest Department, non-official people have always been involved with our censussing and this data is not "Cooked up" as the implication seems to be. We would happy to correct our techniques if some specific fault was pointed out. We would be happy to have Dr. Nair as an observer on our next census.

I would like to make a final point. Absolute numbers of an animal species are less important than the population structure, age class distributions. And the trends over time that matter. Judgements should therefore not be made on "absolute numbers" alone, but the other factors, which are more relevant in conserving and managing a particular eco-system.

To quote Aldo Leopold, "When people run out of ideas, they start counting in the hope that somehow it will give them some......"

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7. SOME OBSERVATION ON WILD BUFFALO, *BUBALUS BUBALIS* LINN., IN KAZIRANGA NATIONAL PARK, ASSAM

INTRODUCTION

There is now a need to determine how far the pure wild strain of the Buffalo in the Kaziranga Sanctuary has been affected by domestic strains. The confusion that has prevailed is evident from the fact that several forms were recognised in earlier literature, such as Blanford (1891) who listed four varieties on the basis of horn shape, colour and size, namely:

A. *Colour Blackish*:
   (a) Horns sub-circular *B. b. bubalis*
   (b) Horns directed mainly outward *B. b. macroceros*

B. *Colour brown dun*: *B. b. fulvus*

C. *Size medium*: *B. b. hosei*

In March 1980, we made an attempt to find answers for the queries that have been often raised in the context of the wild buffalo population at Kaziranga National Park, such as:

(a) How many forms of wild buffalo occur in Kaziranga National Park?
(b) Do feral buffaloes occur in Kaziranga and if so, their identity from the wild stock?
(c) How many of the estimated population of six hundred + wild buffaloes in Kaziranga are really wild?
(d) Do wild buffalo stock mix freely with the feral ones?

We concentrated our efforts in the Baguri Block of the Sanctuary which is a favoured habitat of the buffalo. Of the estimated 660 buffaloes in Kaziranga in 1978 (census by forest department) about 50% was accounted for from Baguri Block. This situation is probably of the extensive grasslands.

We were in Kaziranga National Park from 19 to 24th March, 1980. During this period, we followed buffalo herds on elephant back from dawn to dusk. The observation period was from 6 a.m. to 6 p.m. with afternoon break of 3 hours. Two trained elephants, a male, and a female were hired by us from the Forest Department for six days, and we had a total of 56 hours of observation.

We transected the forest on elephant back in single file. The buffalo herds when sighted were approached carefully. The herd on seeing us would turn towards us stand in alert attentive posture, staring with raised head often for an hour or more. During our observation when we approached certain buffalo herds to within about 500 metres, the whole herd would bold to cover in tall reeds. With other herds we could steadily approach them and station our two elephants right in the midst of the herd. In the remote northern end of the Park, we followed a large herd of 50 buffalo as close as 10 metres.

The herd strength, composition, build, colour and behaviour were noted. We observed several such herds and noted the behaviour when the herd had not located us, when the herd located our position, reaction to our approached, behaviour when we stationed our elephants right in their midst. Behaviour when the herd was moving from one bheel towards another, resting behaviour reaction to disturbance, cow and calf relation, and the behaviour of solitary bulls.

Spots where a particular herd was sighted earlier was revisited to note if that herd kept to the same territory. Villages surrounding the Kaziranga Park were visited to collect information on possible occurrence of feral buffaloes.

RESULTS

In the 6 days of actual field work we spotted 300 + wild buffaloes in the study area.

The herd ranged from 8 to 20 individuals. However, at Borbeel a larger herd of over 40 individuals were sighted. The herd composition was adult females, sub-adult males and females and in two instances adult bulls.

At Baithamari bheel a herd of 19 individuals were sighted (9 females + 6 sub-adults + 4 cows). The animals were blackish grey with subcircular horns and were of large size. In forenoon, when we were one kilometre away from the herd located our position.

On sighting us the herd turned towards us, with head raised, and alertly stared at us. Twenty minutes later we moved towards the herd and reached the edge of the Baithamari Bheel, the buffaloes which were at this stage 300 metres away across the bheel bolted and took cover in the tall reeds growing at the edge of the grass patch.

After a lapse of 20 minutes the herd returned to the bheel and continued to be there when we left the site an hour later. In the afternoon we observed the herd still at the same bheel when we watched them from a concealed observation site. The entire herd was resting excepting two sub-adults and 2 calves which were grazing leisurely. Our observations showed that some buffalo herds like the above one at Baithamari Bheel stare at an intruder for a long time and on closer approach flee to the cover of tall reeds. Smaller buffalo groups, in twos and threes (cows and calves), were inclined to panic and not permit close approach. Solitary bulls invariably fled to cover on sighting us even from a distance of our 800-1000 metres.

At Danga bheel a herd of 17 individuals were sighted (9 adult females, 6 sub-adults and 2 calves). The animals were medium sized, dun coloured and had horns mainly directed outwards but a few had sub-circular horns. The herd sighted us when we were 200 metres from them and on the same side of Danga bheel. On sighting us all the individuals excepting a few cows turned towards us, with their head raised and stood staring at us. The cows continued grazing. After 15 minutes we approached the herds steadily and our two elephants were soon stationed in the midst of the herd. Excepting sub-adult females all individuals resumed grazing. One male sub-adult (horn *c.* 30 cm) suckled from an adult cow for over an hour hardly a few metres away from us. We had similar experience with a large herd of 50 + animals at Borbheel.

Our observations on some buffalo herds like the one sighted at Danga bheel indicated that the individuals were less shy and less inclined to panic, so much so that we could steadily move amidst a herd of over 20 animals. After sometime the older cows and some juveniles, continued their grazing and lost all interest in us. The herds mentioned above invariably were of dun colour.

Our enquiries with villagers in villages on the margins of the Kaziranga Park revealed that there are over 200 animals in the park which have come from Shivsagar area on the northern periphery of the park. These animals identified as "Nepals" by locals, had taken shelter in the Park during high floods in 1976 (?) and since then, had run wild. These feral herds are known to mix with domestic ones and often follow them into the villages. Four such feral ones captured and tamed in 1979 were seen by us.

Some of these dun coloured animals have settled along the southern margin of the park near Baguri Rest House. Similar herds were encountered by us in the western part of the National Park near Kanchanjuri area. We noted two conspicuous whitish hair band one inch wide and 4 inch apart, on throat of all the individuals in the herd sighted by us at Danga Bheel. Similar whitish throat bands were noted on all four individuals, caught and tamed by the villagers.

SUMMARY OF FINDINGS

Buffalo herds with blackish colour and also herds with dun colour were seen in Kaziranga. They also showed different behaviour, that is, buffaloes with blackish colour fled on approach whereas the dun coloured ones were not inclined to panic. The dun coloured buffaloes were encountered within the entire study area.

Two whitish, one inch wide, four inch apart throat bands were seen on the dun colour buffalo herds. These bands are not recorded by earlier observers.

The situation in Kaziranga National Park warrants a systematic study of wild buffalo, particularly their genetic status. We opine that large number of domestic buffaloes have been let loose in the park area. Many may be now feral and this is not a desirable state as ultimately their presence will lead to deterioration of the wild stock.

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8. CAUSES OF MORTALITY IN MAMMALS OF BOVIDAE FAMILY IN CAPTIVITY AND FREE LIVING STATE IN INDIA

Diseases of wild ungulates have considerable epidemiological and ecological significance. Apart from having a direct impact on the wildlife populations themselves, the occurrence of communicable diseases in some of the species, constitute a great hazard to domestic livestock populations, particularly in areas where such diseases have been controlled or eradicated. In order to have effective disease control programmes, both in wild and domestic stock, it is essential to know the natural nidi and host range of various infectious agents.

The infectious diseases of Bovidae reported in India are Rinderpest in gaur, wild buffalo, nilgai, chousingha, Black buck (Hallen *et al.* 1871, Burton 1953, Schaller 1967, Gupta and Verma 1949), Anthrax (Peacock 1933), Foot and Mouth Disease (Ali 1935), tuberculosis in captive antelopes and sheep (Liston and Soparkar 1924) etc. Reports of parasitic infestations in Bovidae are scanty (Pande *et al.* 1970, Patnaik and Acharjyo 1970, Sen Gupta 1974).

This paper describes the causes of mortality among various species of Bovidae family encountered at Zoological Parks, National Parks, Sanctuaries and reserve forests in different parts of the country.

Materials and Methods

The information in respect of mortality recorded during three years (1975-1977) in various species of Bovidae family was obtained from thirteen zoological parks (Bhilai, Bombay, Darjeeling, Delhi, Hyderabad, Junagarh, Kanpur, Mysore, Pune, Renuka (HP), Shillong, Tutikandi (HP), and Visakhapatnam, one National Park and reserve forests in two States (West Bengal and Jammu & Kashmir).

A total of 220 deaths were recorded in various species of animals which included Gaur (*Bos gaurus*—17 cases); Yak (*Bos grunniens* —1); Gnu (*Connochaetini* sp.—1); Black-buck (*Antilope cervicapra*—86); Chousingha (*Tetracerus quadricornis*—27); Nilgai (*Boselaphus tragocamelus*—25); Eland (*Taurotragus oryx* —10); Chinkara (*Gazella gazella*—21); Goitered gazelle (*Gazella subgutturosa*—2), and Goral *Nemorhaedus goral*—18).

Out of these 220 deaths, 8 were recorded in free living state and remaining 212 in captivity.

In addition, 39 cases of deaths were recorded in wild goats and 2 in wild sheep. However, the exact taxonomic nomenclature of these members of sub-family Caprinae could not be determined.

Results and Discussion

The recorded causes of deaths have been classified into specific diseases, non specific disease conditions and diseases due to undetermined etiology. As shown in Table 1, Rinderpest was recorded as a major cause of death in gaur (*B. gaurus*) accounting for 9 out of 17 deaths in this species. Eight cases were recorded at the Hyderabad Zoo and one at the Mysore Zoo. During the rinderpest outbreak at Nehru Zoological Park, Hyderabad in the months of January-February, 1979, all the six animals kept in one enclosure died. No other zoo animal was affected. Cases of Rinderpest had been recorded among pigs in a village close to the zoo, about ten days before the onset of disease in gaurs. The exact source and method of transmission of disease could not be detected.

Among 220 deaths pertaining to 11 species of animals, tuberculosis was recorded only in Blackbuck (*Antilope cervicapra*). Three cases were recorded at Bombay Zoological Garden and two at Delhi Zoological Park. At both the places, tuberculosis was diagnosed also in spotted deer and monkeys. It would appear that among the members of Bovidae family, Black bucks are most susceptible to tuberculosis.

An isolated case of Anthrax was recorded in Chinkara (*G. gazella*) at Kanpur Zoo. No other animal was reported to be affected. Similarly a case of Black Quarter was recorded at Shillong Zoo in Blackbuck.

Deaths due to parasitic diseases were recorded in 14 cases. The cases of babesiosis were recorded in one gaur and one Black buck at Bhilai Zoo and a Chinkara at Kanpur Zoo. Trypanosomiasis in one Nilgai was recorded at Kanpur Zoo. At the Nehru Zoological Park, Hyderabad, one Chinkara died due to Coccidiosis. Helminthic infestations were responsible for six deaths in four species (Yak—1, Blackbuck—2, Chousingha—2, and Goral—1) whereas ectoparasites (unspecified) accounted for 3 deaths in goitered gazelle.

A male wild gaur of about 8 years age died of horn cancer in the reserve forest of Jal-

TABLE 1

RECORDED CAUSES OF DEATHS IN MEMBERS OF BOVIDAE FAMILY

Sl. No.	Causes of death	Gaur	Yak	Gnu	Black buck	Nilgai	Chou- singha	Eland	Chin- kara	Goitered gazelle	Thomson gazelle	Goral	Total
1.	Rinderpest	9	—	—	—	—	—	—	—	—	—	—	9
2.	Tuberculosis	—	—	—	5	—	—	—	—	—	—	—	5
3.	Parasitic* diseases	01 (Bab.)	01 (Fasc)		01 (Bab.) 2 (Taen)	01 (Tryp)	2 (RW)		01 (Bab.) 01 (Cocci)	3 (Ect)	—	01 (Taen)	14
4.	Anaerobic Infections	—	—	—	01 (B.Q.)	—	—	—	01 Anthrax	—	—	—	2
5.	Horn Cancer	01	—	01	—	—	—	—	—	—	—	—	2
6.	Pneumonia	—	—	—	11	6	3	—	2	—	—	8	30
7.	Gastroenteritis	2	—	—	5	02	3	01	—	2	—	6	21
8.	Hepatitis	—	—	—	5	01	—	—	01	—	—	1	8
9.	General debility and anaemia	—	—	—	17	2	4	3	3	5	—	—	34
10.	Dystokia/Metritis	—	—	—	—	1	—	1	—	—	1	—	3
11.	Heat Stress	—	—	—	1	—	2	—	—	1	—	—	4
12.	Navel ill	—	—	—	1	—	—	—	—	—	—	—	1
13.	Tympanitis	—	—	—	2	1	—	—	1	1	—	—	5
14.	Hernia	—	—	—	1	—	—	1	—	—	—	—	2
15.	Injury	4	—	—	22	6	4	2	6	—	—	—	44
16.	Miscellaneous	—	—	—	12	5	9	2	5	0	1	2	36
	TOTAL	17	01	01	86	25	27	10	21	12	2	18	220

* *Abbreviations used*:—Bab = Babesiosis; Cocci = Coccidiosis; Tryp = Tyrpanosomiasis; Taen = Taeniasis; Fasc = Fascioliasis; Ect = Ectoparasite; RW = Roundworm; B.Q. = Black Quarter.

paiguri. A second case of Horn cancer was recorded in a 22 year old male Gnu at Bombay Zoological Gardens.

The deaths due to pneumonia, gastroenteritis, anemia and general debility were recorded in 13.6 per cent, 9.1 per cent and 15.4 per cent of the total deaths respectively. These disease conditions are, to a great extent, due to faulty management or malnutrition and hence can be minimised or prevented by improving the management practices.

Deaths due to injuries were recorded in 20 per cent of the total cases. In the majority of cases, injuries were inflicted during intra or inter species fighting, accidents, or at times, during capture operations for treatment and other managemental purposes. As such, the losses due to trauma can be prevented by using chemical transquillizers and by improving management practices etc.

The disease conditions responsible for mortality in wild goats were Pneumonia (6 cases), gastroenteritis (10), general debility and anaemia (6), injury (5), hepatitis (1), and undetermined causes (11). The recorded causes of mortality in two wild sheep were undetermined etiology (1), enteritis (1).

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9. THE FLAMINGOS OF SAMBHAR LAKE

Sambhar lake is the largest inland alkaline, saline lake in India. It lies in a shallow depression to the east of the Aravalli hills in Central Rajasthan) (27°58′N, 75°55′E) and is approximately 190 sq. km in area. On the eastern side of the lake a big reservoir (41.72 sq. km), salt pans and crystalisers are present which were used for the manufacturing of salt. These water bodies have experienced severe floods during the last decade (1971, 1974, 1975, 1976 and 1977). As a consequence of these floods the salinity has reduced eleven times to what has been previously reported by Baid (1968, Max. 164‰). This drastic change in salinity consequently affected the faunal and floral composition of the lake (Alam 1980).

Two species of flamingos *Phoenicopterus antiquorum* and *Phoeniconaias minor* have been reported from Sambhar lake. Previously the flamingos were casual visitors (Aggarwal 1951, Baid 1968) to the lake. They came to the lake soon after the annual rainfall and lived upon the insect life and algae which flourished in the lake while the density of the brine remained low. They emigrated as soon as the specific gravity of the lake brine increased and all insects and vegetables organisms were destroyed by the rising density of the brine (Aggarwal 1951). However, during the present study (July 1977—June 1978) it was found that flamingos (including the larger *Phoenicopterus roseus*) have become permanently resident but confined only to the reservoir where one could see thousands appearing like pink and white clouds as they rise in flight. This change in habits of the Sambhar flamingos might be due to the availability in the reservoir throughout the year of blue-green algae (*Spirulina* spp.) which is the principal food of the lesser flamingo (Jenkin 1957).

TABLE 1

ABUNDANCE OF TOTAL PHYTOPLAKTON AND CYANOPHYCEAE IN THE SAMBHAR LAKE (L) AND ITS RESERVOIR (R). JULY 1977-JUNE 1978.

		July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June
Total Phytoplankton x 10^4 Units/1	L	15.47	295.48	31.08	923.30	34.50	24.50	56.80	15.00	14.00	28.30	201.00	242.50
	R	342.03	430.77	447.20	1100.32	106.60	108.70	155.80	10.30	123.50	116.70	162.90	728.00
Cyanophyceae %	L	10.08	87.35	70.86	33.23	50.87	37.14	61.62	29.33	27.86	24.38	0.99	23.92
	R	99.39	86.16	52.09	71.27	87.80	84.73	94.09	8.74	87.37	88.35	83.12	99.31
Spirulina %	L	5.88	57.51	20.52	4.96	48.95	29.79	61.61	29.33	29.81	Nil	Nil	0.82
	R	99.12	64.41	20.93	65.65	87.80	82.79	94.03	95.94	87.37	88.34	83.12	99.31

The difference in the nature of the phytoplanktonic composition between the lake and its reservoir might be responsible for the difference in the presence of these birds. The reservoir harboured the blue green-algae (Cyanophyceae) comparatively higher in percentage and dominating over other algae in the most of the observations (Table 1). The percentage of *Spirulina* spp. in the total phytoplankton was always found higher than 50% except in the month of September and the reservoir, whereas in the lake it was found mostly lower in percentage and sometimes totally absent (Table 1). The trophic relationship between *Spirulina* spp. and flamingos has also been reported by Hecky and Kilham (1973) and Melack and Kilham (1974) in the alkaline, saline lakes of East Africa (Nakura and Elmenteita of Kenya; Reshitani and Big Momela of Tanzania).

Besides the *Spirulina* (phytoplankton), zooplankton like copepods (*Cyclops* spp.), Cladocera (*Moina* sp.), Rotifers (*Brachionus* sp.) and *Chironomus* spp. larvae were also found in abundance both in the lake and the reservoir. However, the *Chironomus* spp. on which these birds also feed (Jenkin 1957) were found many times more in the lake than in the reservoir (Alam 1980). But the absence of the flamingos in the lake might be due to the availability of *Chironomus* spp. (bottom dwellers) only in the deep water bottom.

The author is thankful to Dr. S. C. Bhargava for guidance and to Prof. S. D. Misra for providing the laboratory facilities.

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10. BREEDING OF BUSTARDS — AN OBSERVATION IN AUSTRALIA

In our country, the bustards in general and the Great Indian bustard in particular have been very much in the news of late, especially with falconry crossing international borders threatening the very existance of these species. At one time the Great Indian bustard *Choriotis nigriceps* was well distributed over the country spread over the states of Rajasthan, Gujarat, Maharashtra, Madhya Pradesh and Karnataka but is now restricted in numbers, having been shot indiscriminately by trigger happy sportsmen.

The Indian Board for Wildlife, concerned with the species being threatened with extinction, have time & again recommended creation of sanctuaries to conserve these species and also to take up captive breeding. While the Government of Karnataka have created a sanctuary for the blackbuck and the Great Indian bustard at Ranibennur, Maharashtra & Madhya Pradesh are in the process of notifying areas for conserving & breeding the Great Indian bustard and training officials for the purpose.

While these attempts are afoot, given below are some observations made and information collected by the author on breeding the Australian bustard at the Serendip Wildlife Research Station, Victoria, Australia, while attending the National Parks & Reserves Planning & Management Course from February to May 1978, which could be considered for adoption for the breeding of the Great Indian bustard in our country.

The Australian bustard — *Ardeotis australis* is no better off than its Indian counterpart. Known as the 'Plains turkey', once a favourite game bird, this bustard has been made rare or even wiped out in places during the last two centuries. Concerned at the diminishing numbers, the Victoria Fisheries & Wildlife department finally captured & established in 1966, 24 birds in a cleverly designed complex of eight one-acre pens at Serendip. These pens are octagonal in shape (sketch enclosed) and radiate like segments of an orange with an observation tower & feeding & catching enclosure at the centre. In each pen a large male bustard is isolated, but the much smaller females can move through the whole area by means of small gates in the fence which only permits the smaller sized females to pass through. The enclosures should have sufficient cover, e.g. high grass or low shrubs where birds can shelter from wind or human disturbance and can acclamatise themselves to the new surroundings. This would mean planting of the habitat before the desired effect was achieved. Birds are pinioned if open enclosures are used.

Breeding behaviour:

Males reach sexual maturity between 5-7 years & the first female to lay eggs was at the age of 6. Males stand & strut during display with the gular pouch being inflated and the tail reversed over the back. The display occurs between June & November in Victoria where seasonal conditions are stable. Females are quite compatible between themselves and with the males. Several females can nest in one enclosure successfully and usually lay close to the same location each year. Eggs are taken away as soon as the clutch of one or two is completed, for artificial incubation. Attempts at allowing females to hatch their own eggs have been unsuccessful.

Rearing:

1-5 *days*: For the first five days after hatching the young chicks are kept in a box with a number of partitioned sections of dimensions 30 cm W x 58 cm L x 27 cm H. Heating is done by clear carbon heat lamp of 240 W x 115 W, to give floor level heat of 37.5°C. The chicks are fed powdered turkey started crumbles 24% protein, fresh liver (cut in very small pieces) & meal worms (to develop pecking). Chicks are fed with tweezers 4-6 times a day. A clean feather duster is hung in the box at the warm end and the chick soon learns to shelter under it. Bustard chicks are reared in open pens, until twenty-eight days old.

On the 6th day the chicks are placed in a circular pen 30 cm H x 1.5 m in diameter. A thick layer of sand is used on the floor. Young chicks are sometimes agressive & better separated by glass between pens.

After the 11th day the chicks are moved to a large indoor enclosure 1.5 m W x 3 m L x 60 cm high with sand floor. They are more compatible as they grow older, but should be watched closely when put together in a small area.

30 day old chicks are shifted to enclosures 10′W x 30′L with the first 10′ covered in. Clover & lucerne are grown in the enclosures. When the chicks are four months old they are transferred to open enclosures with plently of trees & shrubs.

Diseases: There have been no problem with diseases as the species are very hardy. The main losses are due to fractures of the wings & legs especially when rearing wild caught chicks, due to a combination of insufficient calcium in the diet causing bone deterioration and poor management regarding handling them.

At the time of my visit, Serendip had eight adult males, six adult females twelve years & over. In addition there are seven hand reared *juveniles*, two males & five females.

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11. FEEDING HABITS OF COPPERSMITH *MEGALAIMA HAEMACEPHALA* (MULLER)

The Coppersmith, *Megalaima haemacephala* is a frugivorous bird. Recently a Coppersmith (*Megalaima haemacephala*) was caught in one of the mulberry fields in the campus of the Tamil Nadu Agricultural University, Coimbatore. The bird was kept in a cage and fed with fruits of mulberry, grapes, and *Ficus bengalensis,* thrice daily in the morning, afternoon and evening and the quantity of the fruits consumed each time was recorded. The bird was fed with mulberry for six weeks whereas *Ficus bengalensis* and grapes were restricted to one week only. The data gathered are furnished in the Table 1. The feeding studies reveal that the bird consumed 48.64

Table 1

Types of Food	No. of weeks	Mean quantity of berries consumed in gms/day	Energy* (kilo joules)
Mulberry	I	48.64	100
	II	52.54	108
	III	66.30	136
	IV	75.36	155
	V	74.25	152
	VI	75.77	155
Ficus	I	54.06	163
Grapes	I	35.35	124

* Adopted from Gopalan *et al.* (1971).
1 calorie = 4.184 joule.

to 75.77, 54.06, 35.35 g of mulberry, ficus and grapes respectively. Lack (1954) pointed out that the food requirement of birds may be stated in calories rather than grammes since the quantity of food varies with the nutritive value. Hartley (1964) reported that berry eating thrushes commonly take three full meals a day. According to Kear (1972) small species consume more in proportion to their size than large ones. The present observations indicate that the Coppersmith weighing 30.0 g can consume berris equivalent to 1.6 to 2.6, 1.8 and 1.1 times of its own body weight and feed steadily during the day. It would be necessary to try this experiment with more than one individual before making further conclusions.

The energy requirements of the bird in terms of kilojoules ranged from 100 to 163 per day.

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12. *PERICROCOTUS FLAMMEUS* (FORSTER) IN KUTCH AND SOME GENERAL COMMENTS

December 25, 1980 I saw a female scarlet minivet in my garden here (in Bhuj, and it is still there till today). This is the first time this species has been seen in this area.

Taken by itself, this may be considered as a rare, or accidental occurrence. However if one were to take the appearance of *Pericrocotus flammeus* in Kutch together with that of other birds like the green pigeon (seen on 30th and collected on 31st Jan., 1980 by M. K. Hanvantsinghji at Mata-no-Mad, about 90 km. west of Bhuj), the goldenbacked woodpecker (already reported by me) and several other species which have been recorded for the first time only in the last decade or so, the question would arise as to whether some birds have extended their known ranges. It could very possibly be so owing to favourable changes having taken place in the ecology of some areas through irrigation etc. This can only be confirmed through careful and meticulous monitoring by resident birdwatchers in Kutch.

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13. ON THE VALIDITY OF *TURDOIDES CAUDATUS ECLIPES* (HUME)

In 1877, Hume (*Stray Feathers* 5, p. 337) described a new species of Babbler from north-western India as *Chatorhea* (now *Turdoides*) *eclipes* "Like *C. caudata,* but much larger, the upper surface darker and more strongly striated, tail more strongly banded, feathers of breast and sides dark shafted". He also referred to its being as large as *huttoni* (Blyth, type Kandahar, Afghanistan) from Khelat and Persia, but much darker and warmer coloured than *huttoni* which is paler and greyer, and said the ear-coverts were darker than in *caudatus* in India.

Oates 1889, *Fauna* 1, p. 106, included both *huttoni* and *eclipes* as synonyms of *caudata.* Baker 1922, *Fauna* 1, pp. 198/9, accepted *huttoni* from Afghanistan, Baluchistan and S.E. Persia, as also a specimen from "the Jay River Hills" in Sind as very typical, but said he could not separate *eclipes.* Later, 1926, Ticehurst *JBNHS* 31, p. 491, corrected his earlier (*Ibis* 1922, p. 540) statement that *eclipes* was the same as nominate *caudata.* On p. 694 of the same Journal he re-confirms its distinctness as an interesting form from Rawalpindi, Peshawar (type locality), Campbellpur (south to Kohat?). In *Indian Handbook* (1971) 6, p. 215, it is again synonymised with *caudatus,* while *huttoni* is accepted in West Pakistan.

While cataloguing the Bombay collection it was evident that the birds from the north-west were strikingly different from *caudata* and the characters referred to in the original description were very constant and perhaps justified Hume's statement that it "was far more entitled to specific (now subspecific) distinction than *C. huttoni* Blyth.

The bars on the tail are visible in some *caudatus,* but not in any of the larger races,

	Wing	Bill	Tarsus	Tail
♂♂				
eclipes (5)	82-87 av. 84.6	18.2-20.4 av. 19.6	25.2-27.2 av. 26.4	115-130 av. 120
caudatus (27)	76-83 av. 79	17-20.6 av. 18.7	22.5-28.5 av. 25.9	95-112 av. 108
(IH	76-85	from skull 20-23 over 25	26-29	113-130)
huttoni (4)	84-91 av. 87.5	20.5-22.6 av. 21.6	26.5-30 av. 28.9	104-129 av. 119
(IH ♂♀	85-94	from skull 21-25	28-30	112-128)
♀♀				
eclipes (5)	78-84 av. 80	18-20.6 av. 19.7	21.2-26.5 av. 24.7	94-123 av. 110.4
caudatus (10)	74-81 av. 76.8	18.4-19.5 av. 19	24-29.5 av. 26.3	87-110 av. 102.5
(IH	72-82	from skull 20-22	27-29	101)
huttoni (3)	81, 85, 87	21, 21.6, 21.8	26.6, 27.5, 28.5	102, 106, 107

huttoni and *salvadori* (De Filippi, Shiraz, Fars) from the north and west.

The 11 (5♂♂ 5 ♀♀ 1 o?) available from Peshawar (2), Rawalpindi (5), Campbellpur (1), Jholar, Kala Chitta Hills, Salt Range (1), South Waziristan (1) and Damdil, Waziristan (1) may be said to be of this form, the eastern distributional limit being the Jhelum and not the Indus.

One of us (H.A.) has a note to the effect that Gaston (1975) said that the birds in the Salt Range were larger than those in Delhi, but the source cannot be traced. *Eclipes* is accepted in Peters Checklist vol. X, p. 333 (1964).

The evidence appears to be sufficient to establish the validity of the race *eclipes*.

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14. DESTRUCTION OF PEARL MILLET NURSERY BY SPARROWS *PASSER DOMESTICUS* (LINNAEUS) AND ITS AVOIDANCE

Damage due to bird pests is always taken for granted and is not paid due attention. Birds cause losses to almost all the millet crops throughout the cultivation range and the damage is severe in some places (Jotwani *et al.* 1967). They deserve attention in arid areas where the damage commences from sowing stage and needs protection with suitable pesticide treatment (Bhatnagar 1976).

Sparrows, hitherto considered as the major pest problem in this region for ripening fields of pearl millet, sorghum, sunflower and paddy etc., are now causing concern by widespread destruction of pearl millet crop at the nursery stage. It was observed this year in Kharif 1980, that the pearl millet experimental downy mildew sick plot nursery of about one acre at the College Farm of Andhra Pradesh Agricultural University, Rajendranagar, Hyderabad, was damaged to an extent of 100 per cent. The birds damage the crop before there is evidence for the need to control. The present investigation deals with the attack and nature of damage caused by sparrows, and the effective method employed for its avoidance.

Sparrows visit the field in small or large congregations or even singly and feed on the seed grains. Their colour being similar to that of soil, they are not noticed.

Sparrows expose with their beaks pre-germinated and germinated seeds and pull out the just sprouted seedlings before they establish and also feed on the individual ripening grains. The seedlings which escape and reach vegetative phase have their tiny stems stripped off by the sparrows, and in course of time wither and die. Damage to the whole nursery is enormous and rapid.

Application of 10 per cent BHC-dust @ 12.5 kg./ha applied in a line along the pearl millet rows in combination with careful watch and scaring with sounds made by the beating of empty drums immediately after sowing have provided significant protection against sparrows and the seeds germinated well and grew without any loss.

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15. BIRD DAMAGE IN MAIZE

INTRODUCTION

The Roseringed Parakeet (*Psittacula krameri*) as a bird pest of Maize (*Zea mays*) has been reported by Salim Ali (1974), but the nature and extent of damage is not known. Studies to determine this were undertaken at the Andhra Pradesh Agricultural University at Hyderabad since 1974 and the results obtained are presented here.

MATERIAL AND METHODS

Studies on the bird visitants in Maize were conducted at Maize Research Station, Amberpet, (Hyderabad) during Kharif and Rabi 1974-75 in an area of 900.00 sq. metres and 2190.00 sq. metres respectively. A unit area of 25 x 25 sq. metres was demarcated in a maize field in Kharif and Rabi season for counting birds. The percentage of damage was assessed and compared for the two seasons (Kharif and Rabi) by taking counts of healthy and damaged cobs in this unit area. The bird counts were made in the morning and evening only, since preliminary studies made from dawn to dusk showed these to be the feeding hours. The observations were made with 7 x 50 magnification field binocular to watch the bird pests from a distance. The studies were carried out during the peak hours bird visits from 6 a.m. to 10 a.m. in the morning and 3.00 p.m. to 6.00 p.m. in the afternoon. The

TABLE 1

POPULATION DATA OF BIRD VISITANTS IN MAIZE CROP AT MAIZE RESEARCH STATION, AMBERPET IN KHARIF AND RABI SEASONS

Date	House Crow								Roseringed Parakeet								Indian Myna							
	Morning				Evening			Total	Morning				Evening			Total	Morning				Evening			Total
	6-7	7-8	8-9	9-10	3-4	4-5	5-6		6-7	7-8	8-9	9-10	3-4	4-5	5-6		6-7	7-8	8-9	9-10	3-4	4-5	5-6	
									Kharif — 1974-75															
15-x-1974	24	23	25	25	25	22	15	159	5	6	5	3	6	2	5	32	15	8	7	9	10	13	15	77
16-x-1974	78	91	98	78	20	40	62	467	10	5	5	—	4	10	12	46	10	5	7	3	10	8	4	47
17-x-1974	25	63	70	75	16	39	60	348	2	3	2	1	4	12	10	34	2	1	3	—	10	8	4	28
18-x-1974	38	83	76	67	30	48	52	394	2	3	1	—	2	4	6	18	2	1	2	—	8	6	4	23
19-x-1974	49	69	89	81	40	48	52	428	2	1	3	2	8	9	11	36	3	4	2	1	6	8	—	24
20-x-1974	50	70	81	86	25	40	58	410	2	2	3	1	6	7	9	30	4	5	6	2	9	7	—	33
									Rabi — 1974-75															
23-iii-1975	2	1	1	—	—	1	2	7	5	3	2	1	—	1	4	16	—	—	—	—	—	—	—	—
24-iii-1975	2	1	—	—	—	—	1	4	3	2	1	—	—	1	3	10	—	—	—	—	—	—	—	—
25-iii-1975	1	2	—	—	—	1	1	5	4	3	1	1	—	2	5	16	—	—	—	—	—	—	—	—
26-iii-1975	1	1	—	—	—	—	2	4	3	1	1	—	—	1	2	8	—	—	—	—	—	—	—	—
27-iii-1975	2	1	—	—	—	—	1	4	4	1	—	—	—	2	3	10	—	—	—	—	—	—	—	—
28-iii-1975	1	—	—	—	—	1	1	3	2	1	—	—	—	1	2	6	—	—	—	—	—	—	—	—
29-iii-1975	1	—	—	—	—	—	1	2	2	1	—	—	—	1	2	6	—	—	—	—	—	—	—	—

method adopted for assessing the population in the field was by visual counting. For each bird species the population of birds per hour indicates the total number of a particular bird pest species which visited the fields in different groups at different junctures during the particular hour.

RESULTS AND DISCUSSION

The data recorded showed that the pigeons (*Columba livia*) and House Crows (*Corvus splendens*) were the first to invade the crop after sowing and cause damage at the germination and seedling stages. These pests picked the seed from the field after the post-sowing irrigation and fed on the soaked seeds which were in the process of germination. They also pluck out the developing young seedlings. Damage by these birds was not noticed in the subsequent phases of crop growth.

At the flowering stage, the Roseringed Parakeets (*Psittacula krameri*) infest the male inflorescence (Tassel) and feed on the anthers and pollen grains. At the tender cob stage, the parakeets damage the cobs with the silky style and green husk. This type of damage was negligible compared to the damage at the subsequent milky stage of the cob when they split and strip away the covering (bracts) thereby exposing the grain for easy feeding and further damage. This type of feeding is continued upto maturity of the cob but maximum damage was recorded at the dough stage of the cobs.

Data recorded on the population density of the birds infesting maize crop at the dough stage during the various periods of the day are summarised in Table 1. Damage by crows started after the grains in the cob attained the dough stage. Crows prefer the cobs in which damage was already initiated by parakeets and in such cobs they completely removed the spathes, exposed the cob and ate the grains. However, crows damaging a fresh healthy cob from the apical portion by pulling down the green spathes, is not uncommon. During this process, each green spathe is torn into small pieces to expose the grains fully. Mynas (*Acridotheres tristis*) also visited the crop but only in small numbers and they were mostly seen picking the insects from the fields and occasionally eating a few maize grains.

The damage to maize crop due to bird pests at the cob stage was assessed by taking counts of healthy and damaged cobs in the unit area. The extent of damage in terms of cobs was 82.46% in Kharif and 11.47% in Rabi under unprotected conditions in the field. The higher percentage damage in Kharif can be attributed to a convincingly high population of birds infesting the crops during the Kharif season (Table 1). Further, the standing paddy crop adjacent to the Maize plots in dough stage also served as a source of food for parakeets.

It is inferred from the foregoing that House Crows and Roseringed Parakeets are the major bird pests of maize as observed at the Maize Research Station, Amberpet. However a survey carried out in the cultivators' field in major maize growing areas in Telangana (Karimnagar and Medchal districts) and also as reported by the farmers have shown that crows are not a pest in maize when the crop is grown in large acreage. In experimental plots or in maize crops raised near human habitations, damage by crows may also be evident.

ACKNOWLEDGEMENTS

Thanks are due to the Indian Council of Agricultural Research, New Delhi for financing a scheme for "Studies on the Biology and Control of Bird Pests" under which the studies are carried out.

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ALI, SALIM, AND RIPLEY, S. D. (1969): Handbook of the Birds of India and Pakistan. Vol. 3. Oxford University Press, Bombay.

16. BIRD FAUNA OF THE RICE CROP ECOSYSTEM IN PONDICHERRY REGION

In the rural economy of an agriculturist birds play a vital role since some birds are beneficial or useful to him and others claim a heavy toll of his produce. In this paper an attempt is made to list out the common species of birds both resident and migratory in this region. A detailed observation was made for the insectivorous avian fauna visiting the rice ecosystem throughout the years of 1978-80. The principal agro-ecosystem in Pondicherry region is rice-based and the irrigation needs are met mostly by Ousteri and Bahour tanks and by a network of tube wells. Light rains are received in the South-West monsoon months of July to September and heavy rains during the North-East monsoon months of October to December. The total annual precipitation is around 1200 mm. During the rainy months, the tanks get filled up. From May to February the double cropped wetlands receive canal water and the third crop receives water from tube wells. In some areas of this region paddy remains in fields throughout the year which supports a rich aquatic biome. The aquatic biome of the rice ecosystem includes the invertebrate fauna comprising insect pests like stem borers, leaf rollers, plant hoppers, earhead bugs, blackbugs, grasshoppers etc. The non-pest fauna include waterbugs, beetles, odonates and a variety of other insects. The paddy fields and water storing tanks also harbour fishes, crabs, frogs, snakes and aquatic insects which provide the conditions to attract a host of insectivorous birds to this region. The observations were made in the farm attached to the Krishi Vigyan Kendra and its vicinity, Ousteri and Bahour tanks, and in the different communes like Villianoor, Ariankuppam, Nettapakkam etc. The birds are classified in the following groups.

1. Very common — Seen in large numbers
2. Common — Seen in less numbers
3. Less common — Seen in less numbers and only in certain places
4. Rare — Seen in singles or in few in numbers occasionally.

The birds were compared for identity and

TABLE

Common Name	Scientific Name	Status	Season
Paddybird	*Ardeola grayii*	Very common	Throughout
Cattle egret	*Bubulcus ibis*	Common	Oct-Feb
Redwattled lapwing	*Vanellus indicus*	Common	Throughout
Little ringed plover	*Charadrius dubius*	Common	Throughout
Pintail snipe	*Capella stenura*	Common	Oct-Feb
Blackwinged stilt	*Himantopus himantopus*	Common	Oct-Feb
Avocet	*Recurvirostra avosetta*	Rare	Oct-Feb
Indian whiskered tern	*Chlidonias hybrida*	Common	Oct-Feb
Spotted dove	*Streptopelia chinensis*	Very common	Throughout
Blue rock pigeon	*Columba livia*	Less common	Throughout
Red turtle dove	*Streptopelia tranquebarica*	Less common	Throughout
Roseringed parakeet	*Psittacula krameri*	Common	Throughout
Koel	*Eudynamys scolopacea*	Less common	Nov-Jan
Spotted owlet	*Athene brama*	Common	Throughout
Indian nightjar	*Caprimulgus asiaticus*	Less common	Throughout
House swift	*Apus affinis*	Very common	Throughout
Small blue Kingfisher	*Alcedo atthis*	Common	Throughout
Whitebreasted Kingfisher	*Halcyon smyrnensis*	Common	Throughout
Pied Kingfisher	*Ceryle rudis*	Common	Throughout
Small green bee-eater	*Merops orientalis*	Less common	Throughout
Indian roller	*Coracias benghalensis*	Common	Throughout
Blackbellied finchlark	*Eremopterix grisea*	Very common	Throughout
Crested lark	*Galerida cristata*	Very common	Throughout
Redrumped swallow	*Hirundo daurica*	Common	Throughout
Black drongo	*Dicrurus adsimilis*	Very common	Throughout
Common myna	*Acridotheres tristis*	Very common	Throughout
House crow	*Corvus splendens*	Very common	Throughout
Redvented bulbul	*Pycnonotus cafer*	Less common	Throughout
Jungle babbler	*Turdoides striatus*	Very common	Throughout
Ashy wren-warbler	*Prinia socialis*	Very common	Throughout
Indian robin	*Saxicoloides fulicata*	Common	Throughout
Large pied wagtail	*Motacilla maderaspatensis*	Common	Throughout
House sparrow	*Passer domesticus*	Very common	Throughout
Baya weaver bird	*Ploceus philippinus*	Common	Throughout
Spotted munia	*Lonchura punctulata*	Common	Throughout

nomenclature with the authenticated guides by Fletcher and Inglis (1926), Salim Ali (1977) and Ganguli (1975) and the observations are presented in the table. Among the birds the black drongo, *Dicrurus adsimilis* seems to be a purely insectivorous bird destroying injurious insects like stemborer moths, skippers, leaf rollers etc. in enormous numbers. In company with crows and mynahs this bird is sure to be present in large numbers wherever pest insects are predominant. Drongos were reported to feed mostly on injurious insects (Thirumurthi and Abraham 1975). The house crow, *Corvus splendens* and myna, *Acridotheres tristis* are highly beneficial to the agriculturists as they help to eradicate the soil insects and pupae at the time of ploughing and during and after the harvest. The paddy bird *Ardeola grayii*, always found in paddy fields and in watersheds, is very active and beneficial in fields where young seedlings are cut up by immature crabs. The stilt and pintail snipe found in marshes and paddy stubbles often probe into the mud for worms, larvae and other aquatic insects. The kingfishers, especially *Halcyon smyrnensis*, commonly noticed in rice fields, appear to be important in their predatory habit on insects.

Thus it is evident that certain birds like crow, myna, drongo, paddy bird are useful in the control of injurious insects and hence deserve to be protected and encouraged.

We wish to thank Master Christian Nathan son of the first author for his constant help in field trips and locating the habitats of birds.

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17. SIZE AT FIRST BREEDING IN THE GHARIAL [*GAVIALIS GANGETICUS* (GMELIN)] (REPTILIA, CROCODILIA) IN CAPTIVITY

Size and age at first breeding in the gharial in the wild are not known for either sex. In Katerniaghat Wildlife Sanctuary in Bahraich District, Northern Uttar Pradesh, the smallest breeding female was estimated as 3.12 m during 1977 nesting season (Srivastava 1981).

McCann (1940) in a well-reasoned discussion on the Indian mugger (*Crocodylus palustris*) in the wild, correctly, in our view, stated,

"However, with reptiles, I think, it is perhaps better to arrive at the size at which they breed rather than place any reliance on age."

For captive crocodilians in India prior to initiation of the Government of India Project Crocodile Breeding and Management in 1975, and in many overseas institutions (Bustard 1980) due to poor growth, age is not a valid criterion on which to judge attainment of sexual maturity (Choudhury and Bustard, in press).

Three gharial were reared in captivity at Nandankanan Biological Park, Orissa. This group comprised 1 male and two females. One of these females bred for the first time in 1980 (Bustard and Maharana 1980) at a length of 3.17 m. The other female bred for the first time in 1980 at a length of 3.0 m. We consider these figures to represent the size at first breeding. It should be noted that the figure of 3.12 m given by Srivastava (loc. cit.) falls within this size range.

The gharial is one of the largest species of crocodiles and as such can be expected to attain breeding size at a greater length and age than smaller freshwater species such as the Indian mugger. The Nile crocodile (*Crocodylus niloticus*) provides comparative data for a similar-sized crocodile. Cott (1961) stated that *C. niloticus* attains sexual maturity at a length of 2.7-3.45 m in the female. Guggisberg 1972 stated that more than half of the female *C. niloticus* begin breeding after attaining a length of 3.0 m.

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18. A RECORD (?) GHARIAL CLUTCH

Malcolm Smith (1931) gave the clutch size for the gharial as "40 or more number". Prashad (1914) shot a gravid female gharial at Ferozpore in 1913 which had 32 eggs in the right and 24 in the left oviduct giving a clutch size of 56 eggs. Bustard (1980) provided data on 35 clutches of gharial eggs collected over three nesting seasons (1976, 77 and 78) in Nepal. The mean clutch size was 31.7 and the maximum 61 eggs.

The clutch, which we think constitutes a record, consisted of 97 eggs and was laid in Katerniaghat Wild Life Sanctuary, Bahraich, Northern Uttar Pradesh in Girwa river 3 kms below the border with Nepal at Kotiya Ghat. The clutch was normal in every way. It was collected for hatchery incubation producing 69 hatchlings (71.1% hatch). Can any of your readers provide information on larger gharial clutches or large clutches of mugger or salt-water crocodile eggs?

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19. LIZARDS FROM NORTH-EASTERN INDIA

The reptile collection of the Eastern Regional station, Zoological Survey of India, Shillong, has 22 species of lizards belonging to 14 genera under 6 families. Of these two species were hitherto unknown from this region.

Family GEKKONIDAE

Cnemaspis jerdoni (Theobald)

Specimens examined: 1 ex, INDIA: Meghalaya, Garo Hills, extreme south of Dainadubi forest, 14.4.1971, Coll. R. S. Pillai.

Remark: This species was earlier reported only from south India and Sri Lanka. The specimen though it agrees well with Smith's description of the species, has 11 pairs of femoral pores on each side and 6 preanal pores.

Hemidactylus frenatus Schlegel

Specimens examined: 1 ex, India: Meghalaya, Sonapur IB compound, 27.8.1974, Coll. A. R. Lahiri; 1 exs, Assam, Sibsagar, Kohora Soil Conservation IB, 17.2.1974, Coll. M. M. Datta; 1 ex, Goalpara, Lakhipur IB, 19.1.1972, Coll. S. Biswas; 1 ex, Goalpara, Blodhurari, 4 kms. south-east of forest rest house, 16.1.1972, Coll. S. Biswas; 1 ex, Goalpara, Dudhnai IB, 8.4.1971, Coll. R. S. Pillai; 3 exs, Goalpara, Rongali IB, 12.1.1972, Coll. S. Biswas, 1 ex, Goalpara, Deagdhoa Paharsingpara, about 14 kms. went of Goalparasadar, 17.1.1972 Coll. S. Biswas; 1 ex, Kamrup, Mothongiri IB, 14.12.1974, Coll. K. R. Rao; 1 ex, Tripura, Santir Bari P.W.D. IB, 7.8.1979, Coll. K. P. Singh.

Remarks: The variation in the number and position of the tubercles in this species is already reported by Smith (1935). In one of the present collection, the third and fourth toes originate from a single stalk and the third gets united with the fifth. Some mites were observed on the ventral surface of the body of another specimen.

This is the first record of this species from North-Eastern states.

Family SCIENCIDAE

Lygosoma courcyanum Annandale.

Specimens examined: 1 ex, INDIA: Meghalaya, Khasi Hills, Mawphlang, 21.9.1973, Coll. A. K. Ghosh.

Remarks: Distance between the end of the snout and forelimb contained 2 times in the distance between axilla and groin. Prefontal not in contact with one another. 70 scales down the middle of the back. Limbs short, far apart when adpressed. Total length from snout to vent 54 mm, tail 36 mm. This specimen has an abnormal foot with only a single free digit. The other digits are not differentiated and the sole ends in a conical mass.

Family AGAMIDAE

Ptyctolaemus gularis Peters.

This species is abundant in Shillong. Males of this species are capable of remarkable colour display. During breeding season,, sexual dimorphism is clearly shown by males by the fully extended throat with its conspicuous blue colour. A pale yellow (with a greenish tinge) longitudinal stripe, along the lateral sides on either side, commencing from a little behind the tympanum and extending to one third of the body is very distinct during this time.

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September 4, 1981.

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REFERENCE

SMITH, M. A. (1935): The Fauna of British India, including Ceylon and Burma. Reptilia & Amphibia, Vol. II. Sauria. Taylor & Francis, London.

20. RAT SNAKE SEIZING BABY MUNTJAC

Some women workers on my Coffee Plantation near Manantody, Kerala hearing a young animal crying in distress, found on investigation that a Rat Snake had seized a baby Muntjac. The snake was coiled around the victim, seeing the workers it released its hold and moved off, but the little Muntjac was dead when picked up.

Rat Snakes are quite common on the Plantation and probably live on birds and rats this is the first occasion I have known of a Rat Snake seizing a small deer for its prey.

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E. J. VAN INGEN

21. SUCCESSFUL ARTIFICIAL BREEDING OF *LISSEMYS PUNCTATA GRANOSA* (SMITH)*

INTRODUCTION

The Southern Flap-shell turtle — *Lissemys punctata granosa* (Smith) occurs throughout peninsular India and Sri Lanka. Around Madras this turtle occurs in fairly large numbers and is usually hunted for food by the locals.

Deraniyagala (1953) reports that in *Lissemys punctata ceylonensis,* which he believes as barely seperable from *Lissemys punctata granosa,* breeding maxima are towards the commencement and end of the year. On November 1st, 1980, just after the rains, Chockulingam, an Irula tribal employee at the Madras Snake Park, took me and two of my colleagues on a field survey off the city limits, south of Taramani. Just west of Taramani Radio Station, while walking on the beaten track along the fence of a farm house, Chockulingam pointed to a raised mound of fine, loose, wet sand nearly one foot high. The mound was surrounded by a thick growth of bushes and grasses, receiving filtered sunlight. It was the nest of the Southern flap-shell turtle, *Lissemys punctata granosa.*

MATERIALS AND METHODS

Nest measurements: The nest was opened by us to take back the eggs. It was dug at an angle to the ground surface. The nest depth to the first exposed eggs was 8 cm. The nest chamber measured 8 cm. in diameter. The total depth of the nest was 12 cm. There were 8 eggs in the nest. The eggs were still moist with mucus and were estimated to be 3 days old at the most.

Deraniyagala (1953) reports that *Lissemys punctata ceylonensis* lays 2-6 eggs within a few weeks of one another. Malcolm Smith (1931) reports that 10-12 eggs are laid at a time. Gunther (1864) records a report by Dr. Kelaart about a female *L. p. ceylonensis* which laid three eggs of about 1″ diameter, with a hard, calcareous shell.

Egg measurements: The eggs were perfectly spherical, hard shelled. They measured as follows :

Diameter: 1) 25.9 mm, 2) 26.6 mm, 3) 26.1 mm, 4) 26.6 mm, 5) 26.5 mm

Weight: 1) 11.0 gm, 2) 12.5 gm, 3) 11.0 gm, 4) 11.0 gm, 5) 12.0 gm

Diameter: 6) 26.4 mm, 7) 26.8 mm, 8) 27.5 mm.

Weight: 6) 11.0 gm, 7) 12.0 fim, 8) 11.5 gm.

According to Deraniyagala (1953) *Lissemys p. ceylonensis* eggs measured 30 mm-33 mm and weighed 17 gm-19.5 gm.

Incubation: The eggs were brought to the Snake Park laboratory to be incubated. A plastic shoe box filled with about 8 cm earth and 3 cm air space was used as an incubator. The eggs were placed completely covered with the earth, the box was also kept covered. Moisture on the lid and sides of the box was wiped dry daily.

On May 8th, 1981, 6 months after egg collection, one of the eggs was opened. The embryo within was fully formed with a large amount of yolk. It was alive and pulsating and had a carapace length of 20 mm and it weighed 4 gm, the egg before opening weighed 9 gm.

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* Dr. Robert Webb in his paper 'The identity of *Testudo punctata* Lacepede, 1788 (Testudines, Trionychidae) Webb, 1980 has redescribed the nomenclatural and taxonomic history of that holotype. He has renamed the yellow spotted *Lissemys punctata punctata* of North India as *Lissemys punctata andersoni* and the Southern *Lissemys punctata granosa* as the actual *Lissemys punctata punctata.*

On July 6th, two eggs were opened and found to be infertile. On 20th July two more eggs were opened. The turtles were full term and ready to hatch. On removing the covering thin transparent membrane they wriggled vigorously. The yolk sac was almost completely withdrawn in both turtles. On 22nd July another egg was opened and on 24th July the last two eggs were opened after an incubation period of nearly 9 months. The incubation temperatures were 32.2°C nest; 32.6°C air.

As related to this incubation period, in *Testudo elegans* the incubation period is thought to be 4-5 months—Minton in Prakash (1971). In *Testudo horsfieldi* (Gray) the incubation time is 76 days. Roberts (1975).

In *Trionyx ferox* (Schneider) the incubation period is 56 days — Lardie (1973).

Hatching measurements:

1. R. Lardie: CL 39 mm CB — PL 32 mm — *Trionyx ferox*
2. Deraniyagala: CL 44 mm CB 35 mm PL 41 mm — — Wt. 10 gm *L. p. ceylonensis*
3. M.S.P. 1981: CL 42 mm CB 40 mm PL 39 mm SH 15 mm Wt. 8.2 gm. *L. p. granosa*

CL—Carapace length, CB—Carapace breadth, PL—Plastron length, SH—Shell height

At present the five hatchlings are being fed on earthworms, *Rhacophorus maculatus* tadpoles and wasp and beetle grubs.

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22. A FEW MOMENTS WITH AN EGG LAYING *ISTIBLENNIUS STRIATOMACULATUS*

On January 3, 1980, we were on a field trip as a part of our study programme on the rock-pool ecosystems off Visakhapatnam. While making observations, we were glad to see a ripe female of *Istiblennius striatomaculatus* (Kner 1866) in the process of laying eggs in an empty barnacle, shell at the top of a rock outcropping of a tidepool. It was 3.40 P.M., and the sea had receded exposing the upper one metre of the triangular outcropping rock which was almost dry. The lone fish leaped on to the surface of the steep rock from the water level. Aided by the pelvic fins in holding the rock surface, it started then to climb up by wriggling movements and wagging its tail. After reaching the apex of the rock, it entered an empty barnacle shell containing a little sea water; there it settled with its head protruding. All this it did with much ease and agility, as if it had previous experience of visiting the same spot. Then it began laying eggs. While it was laying eggs no major body convolutions were observed, but for slight movements, probably to spread the eggs, evenly. It remained laying eggs for 4½ minutes and all the time the fish relied on aerial breathing aided by a few gulps of sea water from the barnacle shell. The fish then came out of the barnacle shell and jumped back into the water. After an interval of 12 minutes, it returned to its breeding nest, in the same way as it did before and remained there for 3 minutes. By 4.20 P.M. the tide was rising and we had to leave the place collecting a sample of the eggs. The eggs were dome shaped, attached to floor by sticky disc and measured 0.5-0.6 mm in horizontal axis and 0.4-0.5 mm in vertical axis. The egg was more or less transparent containing an yellow oil globule.

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23. EEL FISHING WITH BRUSH HIDEOUT

From ancient times fishermen of Nepal have developed many and varied fishing tactics to suit local exigencies. One fishing method that deserves special mention could be called the "Brush hideout for eels". This method of fishing is based on the fact that eels frequent weedy lakes and boggy banks of rivers and hide among weeds, and in holes, crevices in the shallows of the lake or river bank during day time. This habit is utilized by experienced fishermen to catch the spiny eels (*Macrognathus aculeatum, M. pancalus*). This method is also effective for catching gar fish (*Xenentodon cancila*) and freshwater eel (*Anguilla bengalensis*) are also caught by this method.

The weedy, shallow section of rivers or lakes with a depth about 2-3 m is selected for fishing. Generally a sheltered back-water is preferred. In such stagnant water, eel carrying capacity is high. A test fishing is carried out in order to gain a rough idea about the species composition of the lake or river section.

Eels are attracted by green twigs of broad leaved plants. Plant species chosen for the purpose vary with the locality. Generally, twigs of pipal (*Ficus religiosa*), Kaniu (*Ficus glomerata*), Fadelo (*Erythrina indica*), Gideri (*Premna integrifolia*). Satibayer (*Rhus parviflora*) (= *Litsea monopetala*) are chosen for the purpose. These plants do not have sharp thorns and are suitable for making brush hideout. Twigs of about 3 metres length are taken for the making the hideout. About 200 twigs are tied together into bundle leaving interstices for keeping stones.

Fresh twigs having a length of three metres are laid parallel and one over the other. A brush bundle is made by juxtaposing about 200 twigs. To create a sheltering den inside the bundle, stones are put inside. The stones also act as sinkers and keep the bundle submerged. The whole bundle is tied securely with green bamboo bark (*chuina*). The bundle should be fastened loosely so that there is enough sheltering space for eels. On some occasions wheat or maize flour soaked with goat blood or mixed with cowdung is put inside the twig bundle.

The brush bundle ready for setting is taken to a suitable section of the river or lake. The bundle is draped externally with leaf of aquatic plants (preferably dead) or rotten. The bundle is trodden under foot and some heavy stones are kept over the bundle to keep it submerged. The hideout bundle is kept undisturbed overnight.

The brush bundle fisher visits the spot early in the morning. He dislodges the stones put over the bundle very carefully so that the sheltering eels are not disturbed. He holds the rear end of the bundle firmly and throws the bundle towards the shore. If he finds many eels wriggling out he encircles the bundle with a cast net and catches them one by one. In this way he explores other bundles set nearby. Usually a fisherman sets three twig bundles at a time in a spot as there is every possibility of theft of the bundle.

In Narayani, Rapti, and Kaligandaki watersheds, fishermen start this fishing activity during September and October. At this time river and lake margin is accessible and become fishable due to the rotting algae. In Rupa and Begnas lake fishing activity is at its peak during November. In the marshlands of *terai* this fishing is productive throughout the year.

Generally armoured eel (*Mastacembelus armatus, M. pancalus*) dominate the catch in Rapti and Narayani watershed. Besides these, Gar fish (*Xenentodon cancila*), Mud eel (*Amphipnous cuchia*) are also fairly well represented in every catch. In the watershed of rivers and lakes of Kaligandaki and Pokhara lakes the Spiny eel (*Macrognathus aculeatum*) predominates in every catch. On some occasions a few freshwater eels (*Anguilla bengalensis*) are also caught. In a twig bundle about 3-5 kg. of fish is harvested. Enquiries show that this method has been in use for over two centuries.

ACKNOWLEDGEMENTS

I am indebted to the National Council for Science and Technology HMG, Nepal, for

financing "Fishing method and Gear Study" scheme, as principal Investigator. I am also thankful to Dr. K. L. Shrestha, secretary of the Council for encouragement and help.

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24. COMMON METHODS OF CATCHING AIR BREATHING FISHES IN DARBHANGA (BIHAR)

From fisheries point of view, Darbhanga is an important district of north Bihar. It lies between 85°31′ and 86°44′ east latitude and 25°28′ and 26°40′ north longitude having a waterspread area of 5,986 ha. The annual freshwater marketable surplus fish of the district has been estimated to over 10,000 tons of which live fish constitute about 28 per cent. In Bihar, seasonal supply of air-breathing fishes comes mostly from the *chaurs*, low lying fields which get inundated by the rising rivulets of the Koshi, which is not considered to be a carp bearing river (Jhingran 1974). Thus, the *chaur* fishery of Darbhanga is dominated mostly by the catfishes, and some miscellaneous varieties.

The *chaurs* surveyed during the present study are seasonal, retaining water with varying depths for 6 to 9 months. The fishes captured are brought to Supaul fish market for disposal which is an important fish assembly centre of this district, situated about 90 km south-east of Darbhanga township. The fish population in the *chaurs* are self-recruited every year through the flood waters. When the rivers recede, the *chaurs* are left with various types of fish and fish seed. The average catch composition of *chaur* fishery has been worked out as carp — 20%, catfish — 15%, air-breathing fish — 45% and miscellaneous — 20%. Fishing in *chaurs* commences from January-February every year when the water level comes down considerably and is continued till June. In the beginning, carps dominate the catch but after March they are replaced by air-breathing and miscellaneous fishes. Fishing starts from early morning and ends by midday. The catch is brought to the assembly centre in split bamboo basket on sling. On an average 300-400 kg fish/day are assembled during December-February and 1,000-2,000 kg during March-June at Supaul market. The fishes are first graded sizewise and specieswise and then sold. The prices of *singhi* and *magur* vary between Rs. 5-7 per kg and Rs. 4-5 per kg respectively.

Although none of the following fishing methods is used exclusively for air-breathing fishes, the catch comprises a majority of these fishes.

Tobacco Poisoning

This method is used during late summer when cracks appear in the earth. The depth of individual cracks varies upto 1.5 m. In this method, fishermen put a few dry leaves (*c* 200 g in weight) of tobacco (*Nicotina* spp.) at the crack mouth and sprinkle water to make them wet. After 30 minutes or so, the wet leaf releases decoction of nicotine which penetrates into the cracks and whatever fish are in the crack come up to the surface within an hour in distress. The catch is mostly *magur* and *singhi*.

Cover Pot or Plunge Basket

A bell-shaped bamboo strip pot, known as '*Tapi*' is cast over the fish in muddy and shallow water areas and whatever fish is present is hand picked. *Tapi* has two openings — top and bottom. The circumferences of these openings are 70 and 20 cm respectively. Its height also varies between 40-60 cm. The gear is very much effective for small murrels but sometimes minnows are also caught.

Apiyar

It is a typical method for capturing air-breathing fishes from the *chaurs* and low-lying paddy fields, particularly at places where there is definite difference in the gradient of the terrain. An artificial barrier, made of earth and aquatic plants, is erected across the lower portion of the terrain with a small opening at a corner. A small circular ditch (sometimes rectangular, 60 x 60 cm), locally known as '*Apiyar*' (also referred as '*Chhoh*' or '*Deba*' according to place of operation), is dug near this opening. A bamboo screen (50 x 70 cm) is fixed vertically at the opening and water is allowed to pass from upper level to lower level. Instinctively, the fishes inhabiting the lower level side start ascending towards upper level zone. In doing so, when fishes come in contact with the split bamboo screen, they jump into the *apiyar* and get trapped. The catch mostly comprises *singhi, magur, koi,* and *murrels.*

Cast Net

Locally it is known as 'phenka jal'. The net is made of either cotton (20/5/1) or synthetic twine (210/2/3). The nets are provided with peripheral pockets (*ghars*), made by folding 4-6 meshes and stiched at the intervals of 6-9 meshes. The pickets are provided with oval shaped iron sinkers, each weighing 50 g. The peripheral circumference of the net varies between 120 and 200 cm and the height between 1.5 and 2.5 m. The mesh size also varies between 5 and 12 mm. The net is either operated from the shore or from a boat to any depth of water. The catch is *koi, singhi,* besides other fishes.

In Darbhanga, air-breathing fishes are also caught through drag net, line fishing and various types of traps in addition to the methods given above but they are not so very common in practice.

ACKNOWLEDGEMENTS

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REFERENCE

JHINGRAN, V. G. (1974): Fish and Fisheries of India. Hindustan Pub. Corpn., New Delhi: 954 p.

25. MORE BUTTERFLIES FROM BOMBAY — 2

Four additions are made here to the list of Butterflies of Bombay and Salsette published in this Journal by Best and others (Vols. *50*: 331-339, *53*: 282-284, *54*: 215-216, *56*: 358-359, *57*: 233-234, *74*: 190-191, *76*: 369, *77*: 531-532).

Precis atlites (Johanssen) — Grey Pansy. In Volume 16 (p. 576) of this Journal L.C.H. Young wrote of this species, "....though it does not occur in the Konkan or nearer Bombay than Goa it is yet found in all the other forest regions of the Peninsula." I saw this butterfly for the first time in the Konkan on 25/xii/1978 at Kihim, Alibag, Kolaba and then in the Borivli National Park on 29/xii/1980, and finally caught one on 6/vii/1980. Also seen near Tulgi at about the same time this year and at Devnar, Bombay on 14/viii/1980.

Bombay may now be considered to be at the north-western limit of the distribution of this butterfly.

Chilades laius laius (Cramer) — Lime Blue. Not recorded earlier from Konkan or North Kanara, I found this on 15/i/1975 in a garden at Devnar which has lime trees growing in it. The specimens are in the dry season form and have the dark clouded discal patch which is supposed to characterise them. They agree with colour plate 175/31 in Lewis (BUTTERFLIES OF THE WORLD). According to Wynter-Blyth (BUTTERFLIES OF THE INDIAN REGION, p. 284) the Lime Blue "is common throughout the plains of India wherever its foodstuffs, lime and Pomelo grow."

Anaphaeis aurota aurota (Fabricius) — Pioneer. Not included in the list mentioned above but Aitken and Comber described it as "More or less common everywhere." in "A list of the Butterflies of the Konkan" (*J. Bombay nat. Hist. Soc.* 15: 51). I found it very abundant in the Borivli National Park on 29/vi/1980 and again at about the same time this year. Also, one male at Devnar on 13/vii/1981.

Sarangesa purendra pandra Evans — Spotted Small Flat. According to Evans (A CATALOGUE OF THE HESPERIIDAE OF EUROPE, ASIA AND AUSTRALIA, p. 119) there are 3♂♂ 2♀♀ of this subspecies in the British Museum (Natural History) from Bombay. Comber (*J. Bombay nat. Hist. Soc.* 15: 357) wrote "Mr. E. H. Aitken found this species by no means uncommon at Vehar in March, and I took several at Matheran in April." Though not found by Best. I took one in the Borivli National Park on 6/viii/1980.

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SALMAN ABDULALI

26. SOME BUTTERFLIES FROM BHUTAN

The butterfly Fauna of India and neighbouring countries has been studied extensively. But there is no specific literature available on the butterflies of Bhutan (Varshney 1977). Hence a small collection of butterflies made by the Society's staff member, Mr. Rex Pimento during the Ornithological Survey of Bhutan in 1973 will be of some interest to the lepidopterist.

Collections were made at Phuntsholing *c* 2000 ft on 30th September and 1st October, Tongsa *c* 7000 ft from 5th to 11th October and Bumthang *c* 9000 ft from 6th to 20th October. Butterflies collected were identified as belonging to the following species.

Family: DANAIDAE

1. **Danaus aglea** (Kluk) Glassy Tiger
   Common at Tongsa and Phuntsholing.
2. **D. melaneus** (Cramer) Chocolate Tiger
   Rare, Single specimen was collected from Tongsa.
3. **D. sita sita** (Kollar) Chestnut Tiger
   Rare, Single specimen was collected at Lodrai (Boorder Road Camp) Near Hatisar.
4. **D. genutia** (Cramer) Common Tiger
   Common at Phuntsholing, Tongsa.

Family: SATYRIDAE

5. **Ypthima hubneri** Kirby Common Fourring
   Common, specimens collected from Phuntsholing.

Family: NYMPHALIDAE

6. **Neptis yerburyi** But. Yerbury's Sailer
   Common, specimens collected from Phuntsholing.
7. **Precis hierta** (Fabricius) Yellow Pansy
   Single ♂ and ♀ was collected from Tongsa on 5th October.
8. **P. iphita** (Cramer) Chocolate Pansy
   Single specimen collected from Tongsa.
9. **Vanessa cardui** (Linnaeus) Painted Lady
   Common, specimens collected from Tongsa & Bumthang.
10. **Argynnis lathonia** (Linnaeus) Queen of Spain Fritillary
    Very common at Tongsa and Bumthang.

Family: ERYCINIDAE

11. **Zemeros flegyas** (Cramer) Punchinello
    Very common, collected from Tongsa, Bumthang and Phuntsholing.
12. **Abisara neophron** (Hewitson) Tailed Judy
    Rare — single specimen collected at Phuntsholing.

Family: LYCAENIDAE

13. **Hypolycaena erylus** (Godart) Common Tit
    Common, two specimens collected from Phuntsholing.

Family: PAPILIONIDAE

14. **Papilio clytia** forma **dissimilis** (Linnaeus) Common Mime
    Common, specimen collected from Phuntsholing.
15. **Papilio polytes** (Linnaeus) Common Mormon
    Common, single butterfly was collected 30 km away from Tongsa.

Family: PIERIDAE

16. **Cepora nerissa phryne** (Fabricius) Common Gull

Wet Season Form, common, collected from Phuntsholing.

17. **Cepora nandina nandina** (Lucas) Lesser Gull
Common, collected from Phuntsholing.
18. **Appias lyncida** M. Chocolate Albatross
Common.
19. **Pieris napi montana** (Linnaeus) Green Veined White
Common.
20. **Ixias pyrene** (Linnaeus) Yellow Orange Tip
Common ♂ & ♀ collected from Tongsa.
21. **Hebomoia glaucippe** (Linnaeus) Great Orange Tip
Common, ♂ & ♀ collected from Phuntsholing, common at Tongsa.
22. **Catopsilia crocale** (Cramer) Common Emigrant
Common at Tongsa, Phuntsholing.

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REFERENCE

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27. STRANGE PRACTICE OF A CATERPILLAR — A CORRECTION

In a note titled "Strange practice of a Caterpillar", (1980, *J. Bombay nat. Hist. Soc. Vol. 76* (2): 368-369) A.S. Bhaduri wrote, "...I found a medium big butterfly with white spotted black wings resting on the wall near that Curcuma plant. It was resting with its forewings upright and slightly apart and the hindwings resting flat, the white spots in the wings thus showing to advantage....I take it to be a Hesperiid."

Sevastopulo in a note with the same title (1981, ibid., 77 (3): 532) wrote, "The butterfly with 'white-spotted black wings' observed on the near-by wall was almost certainly the imago that had emerged from the *Curcuma*-feeding caterpillar, probably *Celaenorrhinus* sp."

Sevastopulo's identification is wrong since (a) *Curcuma* is not a foodplant of *Celaenorrhinus.* In fact *Celaenorrhinus* belongs to subfamily Pyrginae whose foodplants are restricted to the Dicotyledons, whereas *Curcuma* is a Monocotyledon. All Indian Hesperiidae feeding on Monocotyledons belong to subfamily Hesperiinae. (b) *Celaenorrhinus* sp. always settle with both wings flat; not in the manner described by Bhaduri.

On the basis of Bhaduri's description I would identify the butterfly as *Udaspes folus,* or, possibly *Notocrypta* sp.

Incidentally, a caterpillar I found on *Curcuma* in the Borivli National Park, Bombay on 12th July 1981 pupated on the 13th or 14th of that month and the butterfly which emerged on 20th July 1981 turned out to be *Udaspes folus.*

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28. EFFECT OF METEPA ON SOME LARVAL TISSUES OF *MUSCA DOMESTICA NEBULO*

(*With thirteen text-figures*)

Introduction

Recently experiments have been conducted by various workers which show cytological effects of many chemosterilants. For example the germ cell chromosomes fragmented and chromatin clumped and stained atypically when male house flies were treated with apholate or tepa. When female of the house flies were fed on the hempa or apholate, chromatin clumping and vacuolation of the oocytes and nurse cells were caused. In some instances it was followed by degeneration of the cytoplasm and atrophy of the follicular epithelium. All results indicate that both the severity and type of injury produced were frequently more dependent on dosage than on the type of chemosterilant used. Such an experimental evidence goes to suggest that chemosterilants induce sexual sterility by clumping of chromatin, vacuolation of oocytes and degeneration of follicular cells, nurse cells and the germ cell chromosomes in adult house flies. But in what manner the immature stages are affected in the house fly *Musca domestica nebulo*, yet remains to be seen.

In the line of information given above it was considered feasible to see the effect of metepa by treating the eggs and observing any histopathological effects on the larval tissues of the house fly.

Materials and Methods

The flies used during the present studies were obtained from a normal laboratory stock that is being maintained since 1961 at a temperature of 28±1°C and 60 to 70 per cent relative humidity. The flies lay eggs on cotton pads soaked in diluted buffalo milk in the dishes which were replaced by fresh petri dishes at twenty four hours interval. The freshly laid eggs were carefully transferred along with the cotton pads into glass jars for further development. These jars were covered with cloth in order to prevent the larvae from escaping. On the sixth day a layer of dry cotton was added for the pupation of larvae. The pupae were sorted out and kept in petri dishes in cages for the adults to emerge. In order to determine the effect of metepa two hundred eggs from the normal flies were obtained, half of them were allowed to develop without any treatment (served as control) and the remaining hundred were dipped in ethanol solution of metepa of 0.0156 per cent for fifteen minutes. This strength of the ethanol solution by experience was found to be the maximum effective concentration without too much mortality. Living larvae of the first, second and third instar were collected at desired time intervals, fixed and sectioned to see the progress of damage done to the tissues. The idea behind this set of experiments was to determine within possible limitations the cause of mortality of larval stages.

Result and Discussion

The chief interest of workers employing chemosterilizing technique has been to effect a reduction in the population of harmful insects. Their data regarding the efficiency of this system are based on the rate of mortality

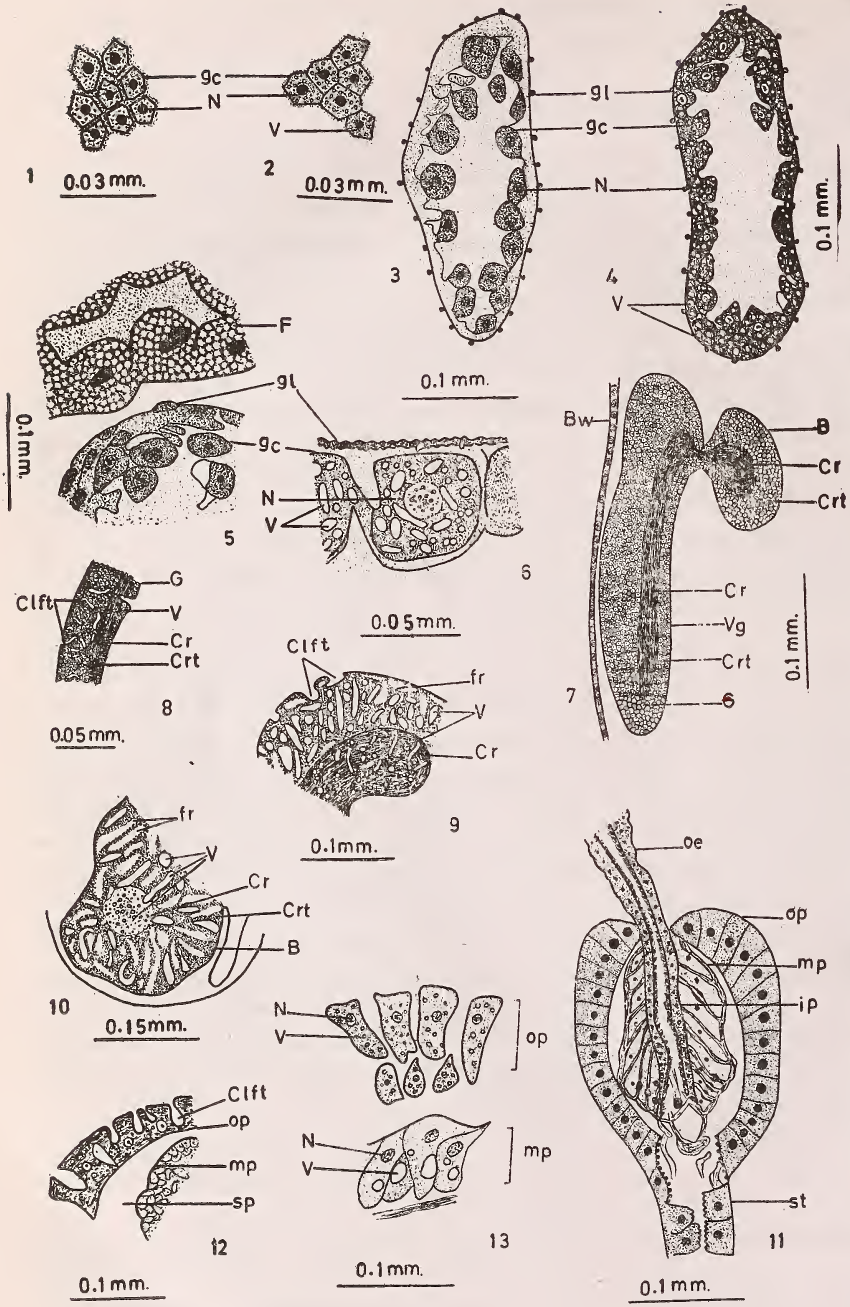
1
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Fig. 1. L.S. of germ cells of normal first instar larva. Fig. 2. Germ cells in the longitudinal section of a first instar metepa treated larva, showing vacuolization of germ cells. Fig. 3. Gonads in the longitudinal section of a second instar normal larva. Fig. 4. Gonads in the longitudinal section of second instar treated larva, showing vacuoles in the germ cells. Fig. 5. An enlarged portion of gonads in the longitudinal section of a third instar normal larva. Fig. 6. An enlarged portion of gonads in the longitudinal section of third instar treated larva, showing larger vacuoles in the germ cells. Fig. 7. Nervous system in longitudinal section of a first instar normal larva, showing brain hemisphere and ventral ganglion. Fig. 8. A portion of ventral ganglion in the longitudinal section of first instar treated larva, note in the core region showing vacuoles and cortical, region showing clefts in between the ganglion cells. Fig. 9. Anterior portion of ventral ganglion in the longitudinal section of treated larva, showing fragmentation of tissue. Fig. 10. Brain hemisphere in the longitudinal section of third instar treated larva, showing vacuolization and fragmentation of tissue. Fig. 11. Proventriculus in a longitudinal section of second instar normal larva, showing the three layers. Fig. 12. A portion of Proventriculus in a longitudinal section of second instar treated larva, showing clefts and vacuolization. Fig. 13. A portion of proventriculus in a longitudinal section of a third instar treated larva, showing fragmentation of tissue.

of various stages of development and the inhibition of the reproductive process in the adults. Few papers, nevertheless, deal with the histological changes that are either the result of toxicity of these chemicals, severly injuring the chromosomes of the sperm and the ovum, or merely interfere with the physiological processes culminating in the failure of the female to oviposit. The later is considered as good criterion in the evaluation of a compound as a chemosterilant. Metepa that has been used in the present experiment in maximum effective concentration without too much mortality (0.0156%) on the eggs of house fly can be considered as a chemical which does not show any marked effect on the germ cells in the first instar larva. A varying degree of vacuolization is however, seen in the tissues of the first instar but without any sign of histolysis in the affected tissue. Besides this there is no other evidence available in the tissues of the first instar larva which could be regarded as relevant from the histopathological point of view. In the later instars a marked degree of fragmentation along with vacuolization is seen in the region of the proventriculus, brain and ventral ganglion. This fragmentation progressively becomes more pronounced in the third instar larva as compared with the section of the normal larva of corresponding stage. The fragmented region shows a dissolution of the cells causing cleft between the healthy tissues. This may be taken as an evidence of the toxic effect of the chemical.

Further, the sterilizing quality assigned to metepa does not seem to express itself during the immature stages. Its sterilizing quality may be evident in the adult flies which would hatch from the treated eggs.

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29. A NEW POD BORER, *ADISURA MARGINALIS* (WALKER) (LEPIDOPTERA: NOCTUIDAE) ON REDGRAM, *CAJANUS CAJAN* (L.)

Under the genus *Adisura,* five species namely *A. atkinsoni* Moore, *A. aerugo* (Feld.), *A. dulcis* Moore, *A. marginalis* (Walker) and *A. straminea* Hampson have been recorded from various parts of the world including India. According to Hampson (1903), *Adisura marginalis* (Walker) is distributed in Sulthanpur (Punjab), Campbellpur, Manpuri, Sikkim, Calcutta and Cuddapah of India. Lefroy (1909) reported *Adisura* (*Chariclea*) *marginalis* (Walker) a pretty pink and yellow moth to be common in the plains of India, but no mention of its host is found in literature.

We observed the infestation of the pod boring caterpillar, *Adisura marginalis* (Walker) on redgram, *Cajanus cajan* at the Main Research Station, University of Agricultural Sciences, Bangalore during September-January 1972-73. The percentage of incidence on tur pods in the field was 6. The insect has been observed on redgram for the first time in Mysore State, and this constituted a new record of host in India.

Adults were Medium-sized moths with light brown forewings; cilia of the forewing were pink at the base and white at tip; hind wings were pale brown in colour. These moths differ from *A. atkinsoni* (the major pod borer moth of *Dolichos lablab*) in having a white costal margin on the forewing. The moths were very active.

The eggs were oval, whitish and laid on flower buds and tender pods. The young caterpillars fed by boring into flower buds and pods. As the caterpillars grew old, they fed on seeds by boring into mature pods. The last instar caterpillars was green in colour, and rarely light brown, with lateral white stripes. The larva of this species differed from that of *Adisura atkinsoni* in the absence of brown markings on the sides of the body. The last instar caterpillars of *A. atkinsoni* and *A. marginalis,* on an average measured 30.0 and 27.4 mm in length, respectively. The full grown caterpillar of *A. marginalis* was also found to curl up when disturbed. Pupation took place in the soil inside an earthen cell.

Detailed studies on its biology and morphology are in progress.

We are thankful to Dr. G. P. Channa Basavanna, Professor of Entomology for providing facilities and encouragement.

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April 25, 1980.

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30. AN AMPLIFIED DESCRIPTION OF A HITHERTO UNCOMMON SPECIES *CRAIBIODENDRON MANNII* W. W. SMITH (ERICACEAE)

(*With nine text-figures*)

Many areas in India still hold several taxa to be discovered and described. Of even more importance is the scanty descriptions of old taxa collected in India by early workers which have not been fully described. The striking example to illustrate this is the uncommon species *Craibiodendron mannii* W. W. Sm. of the Ericaceae which a complete needs redescription. The genus *Craibiodendron* was first founded and described by W. W. Smith (1911), as an honour to Mr. W. G. Craib, on the basis of Burma and Siam specimens of *C. shanicum* deposited, in Kew and Edinburgh herbaria. Subsequently, Smith (1912) described insufficiently *C. mannii* taking the specific epithet from the MS name *Leucothoe mannii* King *et* Prain (MS deposited in CAL). The specimen was collected by Gustav Mann from Juudmaka Pahar of Jowai, near Jaintia Hills, Meghalaya of India. Some plants were also collected by King *et* Prain from the same locality whereas N. L. Bor collected this plant from Naga Hills of Nagaland. Kanjilal (1939) recorded a scanty and quite erroneous description of this plant and also did not illustrate; further he kept it under *Pieris formosa* D. Don. A check of the herbarium sheets of the Eastern Circle of BSI (ASSAM), Shillong, and Forest Research Institute Herbarium (DD), Dehra Dun, has revealed that there is no recent collections of this plant. Further this species differs from the species of the related genera in the presence of terminal spheroidal cells which is evidently a generic feature of the mesophyll of all the other species of *Craibiodendron* (details of which will be published elsewhere).

Craibiodendron

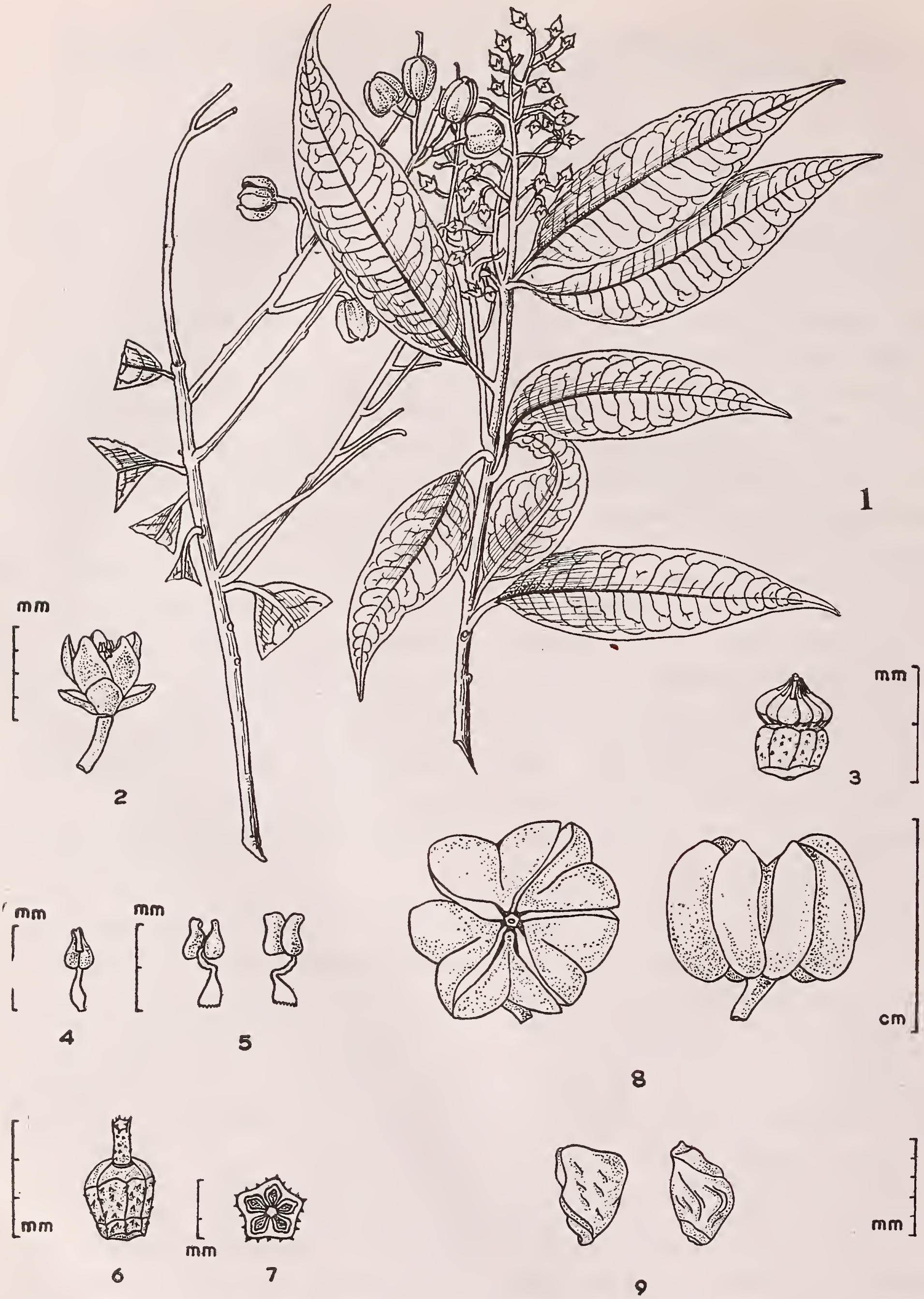
W. W. Sm., Rec. Bot. Surv. India 4: 276. 1911 et Notes R. bot. Gdn. Edinb. 24: 157. 1912; Stevens, Notes R. bot. Gdn. 30(2): 342. 1970 (including *Nuihonia* Dop in Lecomte, Fl. Gen. Indo-China 3: 719. 1930).

Type sp. *C. shanicum* W. W. Sm.

The seven species of this genus is confined to South East Asia. Among them *C. mannii* is endemic in India and restricted to Meghalaya and Nagaland. *C. shanicum* is recorded in Manipur (INDIA) and other regions of South East Asia. The other 5 species have scattered distribution in China, Burma, Cambodia, Laos and Thailand.

Craibiodendron mannii W.W. Sm. Notes R. bot. Gdn. 24: 159. 1912; Kanjilal *et al.* Fl. Assam 3: 151. 1939.

Robust shrubs or small trees. Branches and branchlets glabrous. Leaves 8-8.5 x ± 3 cm, alternate, ovate-lanceolate, apex acute or subobtuse, base cuneate, margins entire, coriaceous, glabrous on both surfaces, nerves *c.* 20-paired, conspicuous on both surfaces, secondary veins brochidodromous, abaxially conspicuous; petioles ± 1 cm, glabrous. Inflorescences raceme, clustered panicle to thyrse, ± 8 cm long, compressed; pedicels ± 0.2 cm; bracteoles 2, deciduous. Flowers *c.* 0.3 x 0.25 cm, pendulous, alternate or opposite but always terminally paired. Sepals 5, ± 0.15 cm long, base slightly imbricate apex free, persistent,


1
mm
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mm
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mm
5
cm
8
mm
6
mm
7
mm
9

Figs. 1-9. *Craibiodendron mannii* W.W. Smith
1. Flowering and fruiting twigs; 2. Flower; 3. Androecium; 4. & 5. Stamens; 6. Ovary; 7. Transection of ovary — axile placentation; 8. Capsule; 9. Triangular seeds unilaterally winged.

tomentose in buds. Corolla tubes 0.25 cm, narrowly campanulate, lobes 5, 0.15 cm long, erect, slightly imbricate, completely joint in buds. Stamens ± 0.2 cm long, filaments adnate at the base of the corolla-tube, lower half pouched, slightly puberulous, base serrulate, falsely adhered on the thalamous, encircling the style base, upper half curled, geniculate, free; anthers 2-lobed, muticous, pseudo-syngenesious; back of the anthers in bud are covered with narrow patches of white deposits of dissolution tissue, composed of unicellular hairs. Ovary ± 0.2 cm x 0.1 cm, apparently oblageniform, superior, covered with triangular worts, 5-chambered; ovules solitary, triangular placentation axile, styles ± 0.1 cm long, warted; stigmas 5-angular, sparsely strigose, projecting. Capsules 1 cm across, puberulous, locules 5, splitting up to the centre at maturity; seeds pendulous, ± 0.5 cm, triangular, unilaterally winged. (Figs. 1-9).

Type: Meghalaya, Juudmaka Pahar (6000 ft), August 1891. G. Mann s.n. (CAL).

Specimens examined:

India-Nagaland, Naga Hills, *N. L. Bor* 2828 (ASSAM); Jowai, Dr. King's collector *s. n.;* Jaintia hills, Dr. King's collector *s. n.;* Juudmaka Pahar, *G. Mann s. n.* (CAL); Naga hills, *N. L. Bor* 6271, 2828 (DD). *C. shanicum* W. W. Sm., India-Manipur, Shugnu, *D. B. Deb* 2633 (CAL).

Acknowledgements

We wish to thank Dr. J. Joseph, Deputy Director, Eastern Circle, B.S.I., Shillong, and Sri K. M. Vaid, Systematic Botany Branch, Forest Research Institute, Dehra Dun, for sending the herbarium specimens for our study.

Botanical Survey of India,
Howrah-711 103,
July 22, 1980.

T. ANANDA RAO
SWAPNA CHAKRABORTI

31. *LYCIUM CHINENSE* MILL. (SOLANACEAE) FROM INDIA

(*With a text-figure*)

Lycium chinense Mill. — a native of China and Japan, also growing in Tibet and cultivated in Eastern Asia for showy rambling habit, evergreen leaves and colourful berries — is now recorded here for the first time in India from West Bengal.

The occurrence of this taxon in West Bengal suggests its introduction by human agency at an earlier date and subsequent migration either directly through North Bengal or through Assam via Tibet into Eastern India or as garden escape.

A concise description alongwith an illustration of this taxon is provided here.

Lycium chinense Mill. Gard. Dict. ed. VIII n. 5. 1768; Bailey Stand. Cyclop. Hort. 4 (L-O): 1930. 1916 and Manual Cult. Pl. 872. 1924; Baker and Bakhuizen f. Fl. Java 2: 467. 1965.

Erect to rambling shrub, much branched, older twigs often with few spines. Leaves alternate and fascicled, very variable in size and

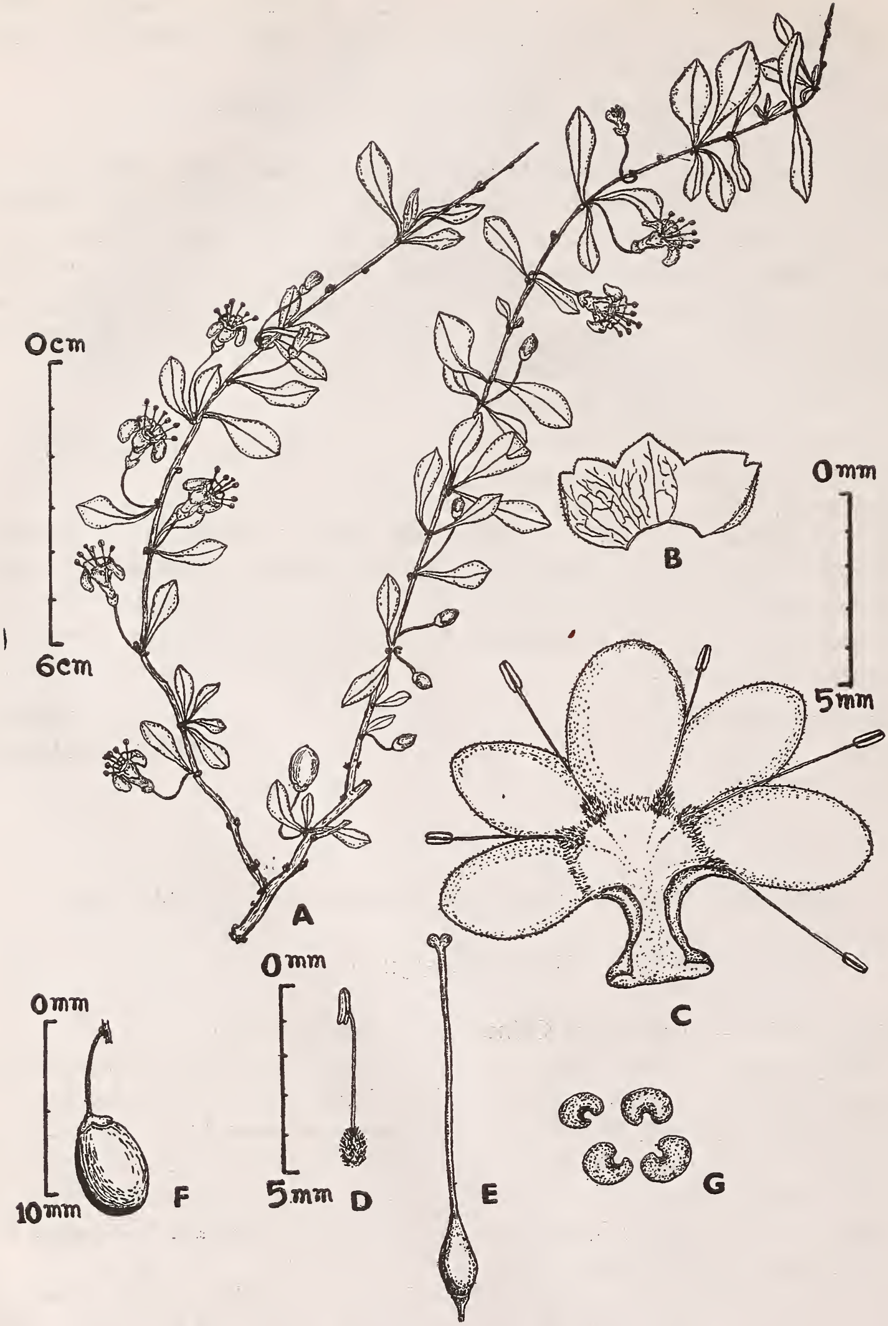

0cm
6cm
A
B
0mm
5mm
C
0mm
5mm
D
E
0mm
10mm
F
G

Fig. 1. *Lycium chinense* Mill.
A. Habit (in part); B. Calyx; C. Split Corolla; D. Stamen; E. Pistil; F. Fruit; G. Seeds.

shape, 1-4.5 cm x 0.5-1 cm, obovate-rhomboid spathulate, acute, entire, base cuneate to attenuate gradually ends in short 5-8 mm long narrow petiole. Flowers axillary, solitary or fascicled, 1-2 flowered; pedicels slender, 10 mm long, glabrous. Calyx irregularly 5-lobed, 1-1.5 mm union, two lobes united of two and one alone, ovate, 2 mm x 1-1.2 mm, acute, ciliate at apex margin as well as subciliate to the outer surface. Corolla 5-lobed slightly heteromorphic, 2 broader and 3 smaller, salver-shaped, tube 3 mm long, shorter than lobes, constricted at 1.5 mm above base, lobes ovate elliptic, 4-4.2 mm x 2.8-3 mm, reflexed during anthesis, margin minutely ciliate, base with a ring of minute hairs alongwith the filaments base. Stamens 5, slightly unequal in length, 2 longer and 3 smaller, filaments 5.5-6 mm long, exserted, base swollen with a tuft of hairs; anthers 1.5 mm long, oblong, 1-celled, longitudinally dehiscent. Ovary oblong, 2 mm long, 2-celled, few to many ovuled; style 8 mm long, slender, glabrous; stigma bilobed, widened. Berry ovoid-ellipsoid, 6-8 mm diam.; seeds many, descending imbricate, reniform-circular, 2 mm x 1.5-1.8 mm, compressed, orange brown, finely reticulate (Fig. A-G).

Flowers and *fruits* — January to April.

Rare, in waste land.

Field notes: This species was found growing in open association with *Alternanthera sessilis* (Linn.) R. Br. ex DC. *Cleome gynandra* Linn., *Coccinia grandis* (Linn.) Voight, *Cynodon dactylon* Pers., *Imperata cylindrica* (Linn.) Beauv., *Malachra capitata* Linn.

Specimens examined:

India: West Bengal; 24-Parganas, Titagarh, *Das* s. n. (CAL).

China: *Hupeh* 3346 (CAL) *Yokohama* s. n. (CAL) (Fokein China, *Dunn s. n.* (CAL).

Japan: *Maximowicz* s. n. (CAL)

Tibet: Shanghi; A-C *Maingay* 297 & 680 (CAL) Pinfa kweichow; *Y. Tsiang* 5396 (CAL); *Djeddu* s. n. (CAL); Lhassa; *Dungboo* s. n. (CAL).

In India three other species as *L. europaeum* L., *L. barbatum* L. and *L. ruthenieum* Murr. are growing in Rajasthan, Punjab and Kashmir. The present taxon is closely related to the last one. A key to all Indian species presented here to facilitate the identification of Indian *Lycium* L.

A. Leaves linear-oblong; filaments glabrous throughout;
  B Corolla lobes not half so long as the tube ... *europaeum*
  BB Corolla lobes more than half as the tube ... *barbatum*
AA Leaves linear or ovate-rhomboid spathulate, filaments at base swollen and hairy;
  B' Leaves linear, 2-5 cm long with rounded to obtuse apex; flowers 4-5 in each cluster; berry globose, few seeded ... *ruthenieum*
  B'B' Leaves obovate — rhomboid spathulate, 1-4.5 cm long apex acute, flowers 1-2 in each cluster, berry ovoid to ellipsoid, many seeded ... *chinense*

BARIN GHOSH
GOUR GOPAL MAITY

BOTANICAL SURVEY OF INDIA,
INDIAN BOTANIC GARDEN,
HOWRAH-711 103,
November 15, 1980.

32. *GENTIANA PROSTRATA* HAENKE VAR. *MANGOLICA* KUSN. (GENTIANACEAE) — A NEW RECORD FOR INDIA

(*With seven text-figures*)

While engaged in revising the fam. Gentianaceae, at Botanical Survey of India, Northern Circle, Dehra Dun (BSD), a few specimens collected by Dr. U. C. Bhattacharyya, were found to be *Gentiana prostrata* Haenke var. *mangolica* Kusn. (1904). Comparison with a duplicate of the syntype of var. *mangolica* Kusn., at CAL confirmed the identity.

Further the list of Indian Gentianaceae, revealed that the taxon, is new to India.

The var. *mangolica* Kusn. is quite distinct from other varieties of *Gentiana prostrata* Haenke. The rotundate apices of corolla lobes, oblong capsule with rounded base and larger size of seeds are good differentiating characters of the taxon from allied ones. The full citation and distribution etc. is as follows —

Gentiana prostrata Haenke var. *mangolica* Kusn. in Acta Horti Petrop. 15 (3): 369. 1904.

Syntypes: Mongolia: Kossogol, *Czekanowsky s. n.* (LE); Ubsa, *Potanin* (LE); Korea 11000-12000 ft (± 3594-3920 m), 1885, *Przewalsky s. n.* (LE, Dupl. CAL!)

Etymology: Named on type locality, Mongolia.

Distribution: INDIA: Jammu & Kashmir, Mongolia.

Specimens Examined: JAMMU & KASHMIR — Ladakh, Debring, Rupshu, 4600 m, 4 Sept. 1970, *Bhattacharyya* 41003A (BSD).

Since in literature there is no illustration of the taxon, a figure of the habit-sketch, enlarged and opened floral parts, is being given here.

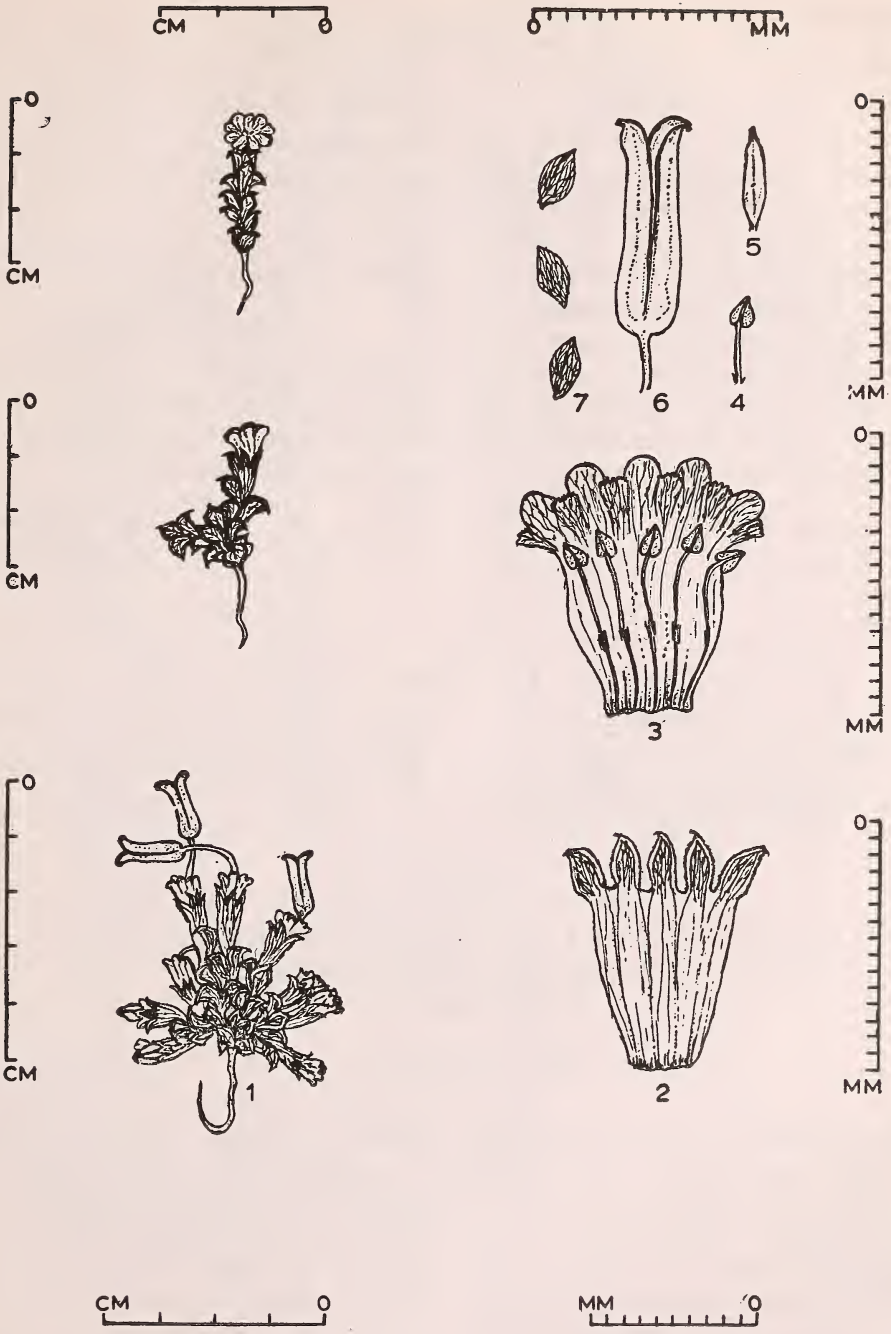
WEALTH OF INDIA, BOTANY SECTION,
PUBLICATIONS & INFORMATION
DIRECTORATE (CSIR),
NEW DELHI-12,
September 8, 1981.

SUNITA AGRAWAL

33. RECORD OF *PLANTAGO AFRA* LINN. (PLANTAGINACEAE) FROM MAHARASHTRA

While studying the specimens of *Plantago* Linn. in the herbarium of the Western Circle of Botanical Survey of India (*BSI*) at Pune, some unidentified specimens kept under a species folder labelled as *Plantago species dubia* were critically examined and subsequently identified as *Plantago afra* L., which is a native of Mediterranean region. J. D. Hooker (1885) reported it from 'North-Western Punjab'. This plant has not been reported by Cooke (1906). Subsequently it was reported by Chohan and Shah (1965) from Gujarat State, as a weed in *Cuminum cyminum* Linn. fields. This is the first record of this taxon from Maharashtra. The plant is medicinally and economically useful (Anonymous 1969). Its citation and brief description are as follows:

Plantago afra Linn. Sp. Pl. ed. 2. 168. 1762;



Figs. 1-7. *Gentiana prostrata* Haenke var. *mangolica* Kusn.
1. Habit sketch; 2. Calyx (opened); 3. Corolla (opened); 4. Stamen; 5. Gynoecium; 6. Capsule; 7. Seeds.

Verdc. in Kew Bull. 23: 509. 1969. *P. psyllium* Linn. Sp. Pl. ed. 2. 167. 1762. non Linn. Sp. Pl. 115. 1753; Hook. f. Fl. Brit. Ind. 4: 707. 1885; Bamber, Pl. Punj. 426. 1916.

Erect, branched herbs up to 14 cm tall. Young branches glandular-pubescent. Leaves cauline, linear, upto 4 cm long, opposite or sub-opposite. Flowers in spikes on axillary peduncles. Spikes up to 1.2 cm long, ovoid, bracts upto 0.7 cm long, with grandular and simple hairs. Calyx lobes with scarious, glandular and simple hairy margins. Corolla tube rugulose, lobes ovate, acute. Stamens 4. Style hairy, stigmas 2. Fruit circumscissile a little below the middle. Seeds boat shaped.

Illus: *P. psyllium* Linn. *l.c.*: Chohan and Shah, J. Bombay nat. Hist. Soc. 62: 327. fig. 1-4. 1965; *P. afra* Linn. *l.c.*: Verdc. in Milne Redhead and Polhill, Fl. Trop. E. Africa, Plantaginaceae 6. fig. 1/10. 1971; Kazmi in Nasir and Ali, Fl. W. Pak. no. 62: 19, fig. 3A-B. 1974.

Fl. & Frt.: July. *Loc.*: Poonagiri, 9-7-1925 (without collector's name and number).

ACKNOWLEDGEMENTS

We are thankful to the Director, Botanical Survey of India, Howrah and the Deputy Director, Western Circle, Botanical Survey of India, Pune for facilities.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE,
PUNE-411 001,
June 18, 1980.

S. KARTHIKEYAN
ANAND KUMAR

REFERENCES

ANONYMOUS (1969): The Wealth of India 8: 153. fig. 53. CSIR, New Delhi.

CHOHAN, J. G. & SHAH, G. L. (1965): On the occurrence of *Plantago psyllium* Linn. in Gujarat. *J. Bombay nat. Hist. Soc. 62*: 327.

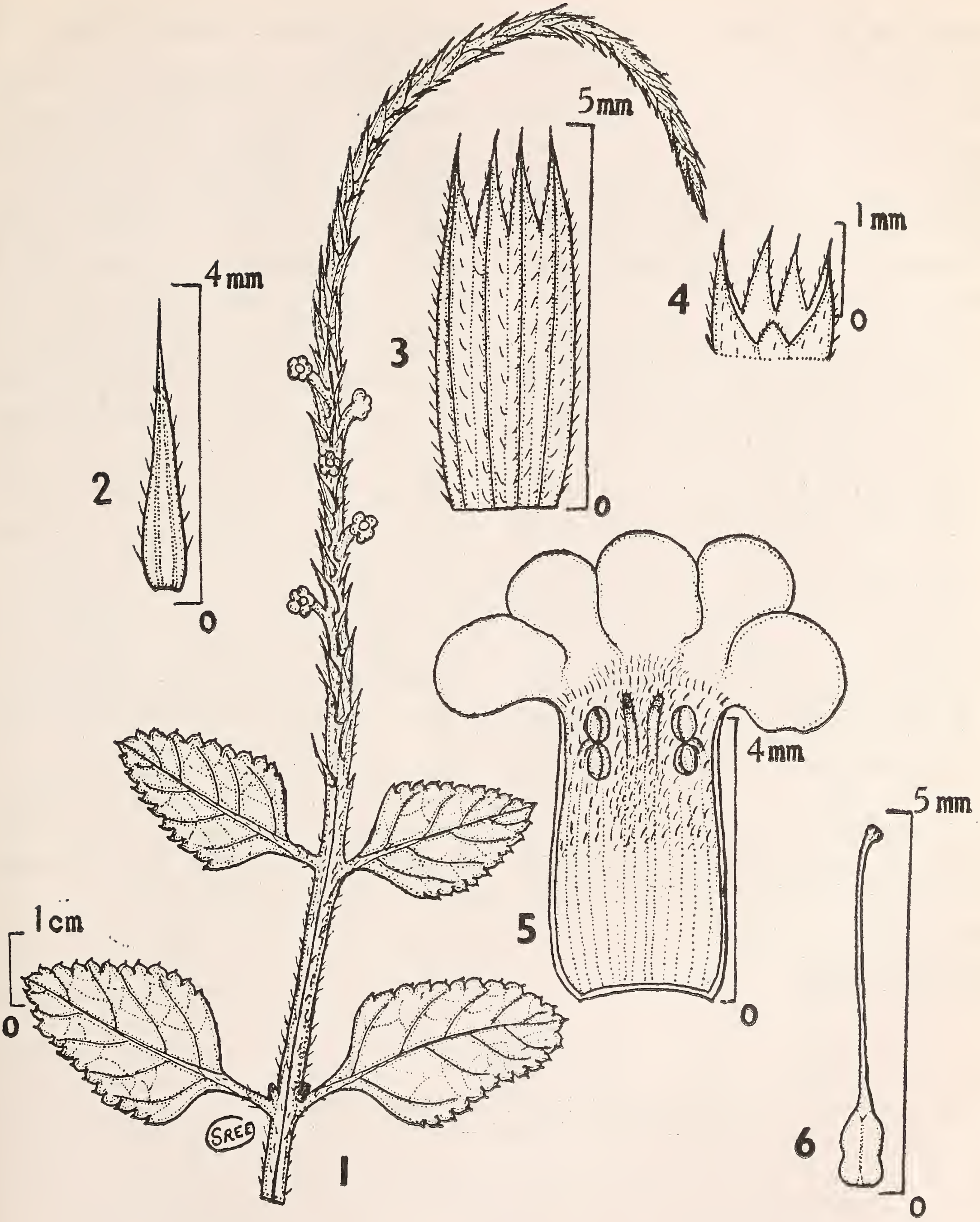
COOKE, T. (1906): Flora of the Presidency of Bombay. Vol. II. London.

HOOKER, J. D. (1885): The Flora of British India. Vol. 4. Kent.

34. *STACHYTARPHETA CAYENNENSIS* (L. C. RICH.) SCHAU. — A NEW RECORD FOR INDIA AND WITH A KEY TO THE INDIAN SPECIES

(*With six text-figures*)

According to literature available at hand the American genus *Stachytarpheta* Vahl (Verbenaceae) is commonly represented in India, by the naturalised species *Stachytarpheta indica* (Linn.) Vahl and *S. jamaicensis* Vahl as weeds of waste places in almost all parts of the country. Another species, *Stachytarpheta mutabilis* (Jacq.) Vahl, has recently been introduced into some of the Indian Gardens in the hills and is sometimes found as an escape. A fourth species is now rapidly spreading as a weed in the southern part of the Peninsular India, particularly as undergrowth among plantations and along the banks of canals, streams and rivers creating some concern among people about future consequences. When and how this plant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4mm
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5 mm
1cm
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SREE
1
6
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Figs. 1-6. *Stachytarpheta cayennensis* (L. C. Rich.) Schau.
1. A branch; 2. Bract; 3. Calyx tube showing the four prominent teeth; 4. Part of calyx tube showing the fifth tooth; 5. Corolla split opened; 6. Gynoecium.

entered into this country is not known. It closely resembles *Stachytarpheta indica* (Linn.) Vahl and is usually mistaken to be the same species. On closer scrutiny this new entrant turned out to be *S. cayennensis* (L. C. Rich.) Schau., a native of Tropical America, now running wild in Africa (Brenan 1950). *Stachytarpheta cayennensis* (L. C. Rich.) Schau. can be distinguished from other Indian species using the following key:—

1. Calyx 10-14 mm long; spike 40-100 cm long; *c.* 5 mm across; bracts 10-12 mm long; limb of corolla 15 mm across .... *S. mutabilis*
1. Calyx 4-6 mm long; spike 15-40 cm long, *c.* 2.5 mm across; bracts 4-5 mm long; limb of corolla 7-12 mm across 2
2. Calyx teeth 5, 4 teeth more or less equal in length, fifth one very short; bracts 0.5-1 mm wide, prominently ciliate on margins .... *S. cayennensis*
2. Calyx teeth 4, all equal in length or nearly so; bracts 1.25-2.5 mm wide, obscurely ciliate on margins 3
3. Leaves ovate or ovate-elliptic, coarsely crenate-serrate, pale green; secondary lateral nerves prominent beneath .... *S. jamaicensis*
3. Leaves oblong or subovate, finely serrate, bright green; secondary lateral nerves not prominent beneath .... *S. indica*

A description of the species, and figures are provided for easy determination of the taxon. The specimens cited are deposited in the Herbarium of Botanical Survey of India, Coimbatore (MH).

Stachytarpheta cayennensis (L. C. Rich.) Schau. in DC. Prodr. 11: 562. 1847; Danser in Ann. Jard. Bot. Buitenz. 40: 2. 1929, Brenan in Kew Bull. 5: 223. 1950.

Undershrub, *c.* 1 m high; branches slender, pubescent. Leaves 1-5 x 0.5-3 cm, opposite, ovate to oval-elliptic, more or less densely hairy on nerves; crenate-serrate with 10-18 serratures on either side, obtuse at apex, oblique at base. Flowers in axillary and terminal, pubescent spikes 15-23 cm long and *c.* 3 mm across; bracts, *c* 4 mm long, linear-lanceolate, ciliate on margins. Calyx tube 4-5 mm long, 1.5-2 mm across, narrowly cylindric, pubescent; teeth 5, 4 posterior on the anticous (outer) side, unequal; fifth tooth very small. Corolla white; tube 4-5 mm long, hirsute on throat; lobes 5, each *c.* 1.5 mm long. Perfect stamens 2, epipetalous, included; filaments very short, pubescent; staminodes 2, hairy. Ovary 2-loculed, ovules solitary; style filiform; stigma capitate or slightly bilobed. Fruit 3-3.5 mm long, *c.* 1 mm across, glabrous.

Distribution: Tropical America, Africa.

Specimens examined: KERALA. Quilon Dt.: Placherry, Ranni R.F., 16-12-1979, *C. N. Mohanan* 63767; Alleppey Dt.: Nedumudy, 3-3-1980, *P. V. Sreekumar* 67040.

BOTANICAL SURVEY OF INDIA,
COIMBATORE, TAMIL NADU,
September 8, 1980.

N. C. NAIR
C. N. MOHANAN
P. V. SREEKUMAR

REFERENCE

BRENAN, J. P. M. (1950): Plants of the Cambridge expedition 1947-1948 — I. *Kew Bull.* 5: 223.

35. *STACHYTARPHETA DICHOTOMA* VAHL (VERBENACEAE) — A NEW RECORD FOR INDIA

(*With a text-figure*)

The genus *Stachytarpheta* Vahl is represented by 2 species in India — *S. indica* Vahl (*S. jamaicensis* Vahl) and *S. mutabilis* Vahl. During the course of a botanical exploration in Garo Hills in Meghalaya, another interesting species was collected as a dominant weed along roadsides and in forest clearings. The species was identified as *S. dichotoma* Vahl. Reference to literature reveals that this species, like most other species of the genus is mostly confined to tropical American countries and thus the present report from Meghalaya forms a new record for India

Stachytarpheta dichotoma closely resembles *S. indica* and some of the sheets have been wrongly identified as *S. indica* in the Assam

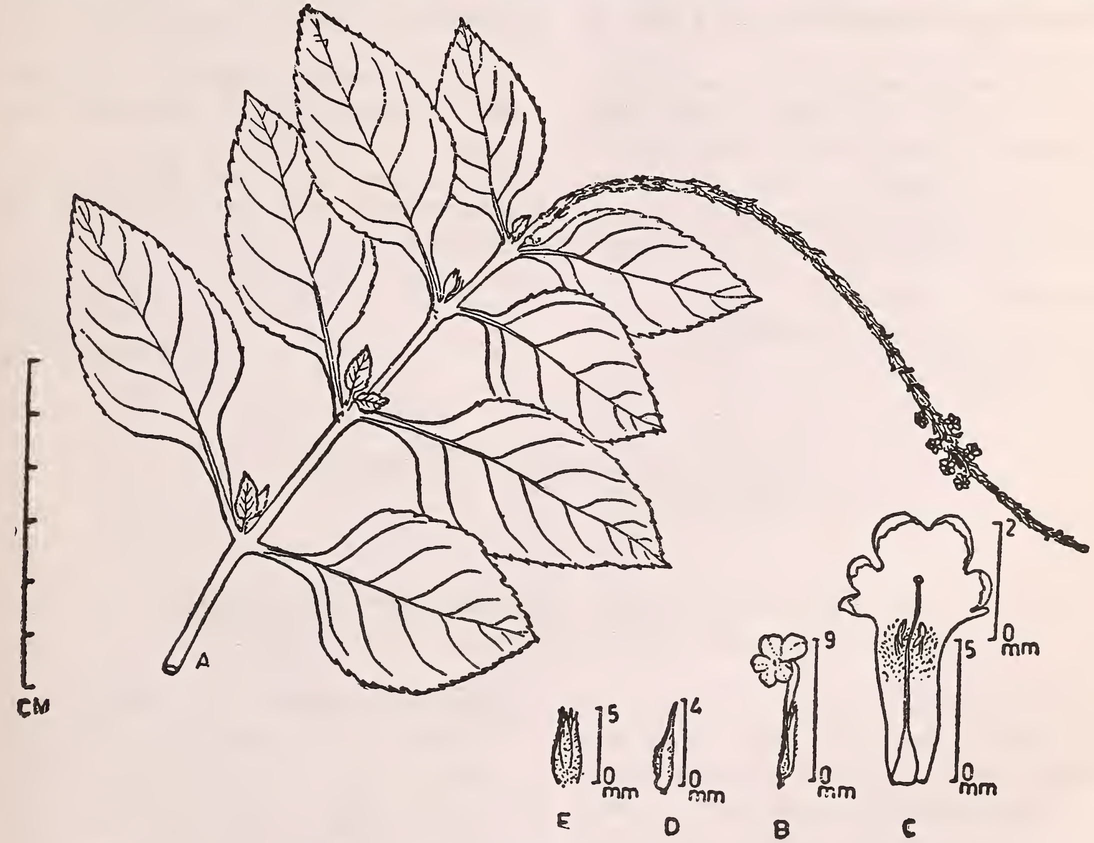

Fig. 1. *Stachytarpheta dichotoma* Vahl.
A — a twig; B — flower; C — flower cut-open showing stamen & pistil; D — bract; E — calyx.

herbarium. Probably this species may also occur in other parts of the country, and is being confused with the other species. However, the present species can be separated from *S. indica* as follows:

Branches green, spikes erect; corolla deep blue; limb 6-8 mm across, tube 6-8 mm long.. *indica*

Branches purple or green; spikes decurved or drooping; corolla light blue turning white; limb 3-4 mm across; tube 4-5 mm long....*dichotoma*

Detailed description along with illustrations of the plant are given to facilitate its easy identification.

Stachytarpheta dichotoma Vahl, Enum. Pl. 1: 207. 1805.

Much branched undershrubs; branches dichotomous, purplish or sometimes green, faintly quadrangular, sparsely hairy; leaves 5-10 x 2-4.5 cm, ovate-elliptic, dentate, base decurrent along the petiole; flowers sessile, immersed in long, slender decurved spikes, bracteate; bracts lanceolate-subulate, 4-4.5 mm long (D); spikes 10-30 cm long; calyx tubular, 5-ribbed, 5 mm long (E); corolla salver-shaped, light blue turning to white (C); limb 3-4 mm across, oblique, 5-lobed; tube curved, 5 mm long, hairy within (C); stamens 2, filaments slender, included; ovary 2 locular, ovule 1 in each locule; style long, filiform, persistent; stigma capitate; drupe firmly enclosed in the calyx tube, breaking up into two 1-seeded pyrenes.

Fls & Frts.: Major part of the year.

Notes: Native to Tropical America, fairly naturalized in Meghalaya, specially in Garo Hills.

Specimens studied: Meghalaya: Garo Hills-Tasek *B. Neogi* 3569; *K. Haridasan* 4110, Darugiri 4125 (*NEHU).

We are thankful to the Director, Royal Botanic Garden, Kew for determining our specimens.

DEPARTMENT OF BOTANY,
NORTH-EASTERN HILL UNIVERSITY,
SHILLONG-793 014,
July 22, 1980.

R. R. RAO
B. NEOGI
K. HARIDASAN

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* The abbreviation 'NEHU' is yet to find a place in '*Index Herbarium*'.

36. NOTES ON THREE RARE AND INTERESTING ORCHIDS COLLECTED FROM TRIVANDRUM DISTRICT, KERALA

The systematic and intensive exploration of the botany of Trivandrum Dt., Kerala have so far resulted in the rediscovery of a number of rare and little known plants. Notes on three rare terrestrial orchids namely *Aphyllorchis montana* (Thw.) Reichb. f., *Eulophia cellenii* (Wight) Blume and *Malaxis latifolia* Sm. are presented in this paper.

Aphyllorchis montana (Thw.) Reichb. f. in Linnaea 41: 57. 1876; Hook f. Fl. Brit. India 6: 116. 1890; Fischer in Gamble, Fl. Pres. Madras 3: 1014. 1957 (repr. ed.); King & Pantl. in Ann. Roy. Bot. Gard. Calcutta 8: t. 349. 1898. *Apaturia montana* Thw. Enum. 301. 1861.

Terrestrial, saprophytic herbs devoid of chlorophyll, 50-60 cm high; stems sheathed. Basal sheaths 1 cm long, close; upper 1.5 cm long, 4-5 cm apart. Flowers straw-coloured in racemes upto 20 cm long; bracts up to 1 cm long, lanceolate. Sepals up to 1 cm long, ovate, obtuse. Petals up to 1 cm long with a prominent mid rib; lip 1 x 0.5 cm, 3-lobed, broader than the sepals, clawed, mid lobe tapering towards the apex into an obtuse tip, side lobes rounded; column 9 mm long; stigma short, ovate; anthers 2-celled; pollinia 2, each 2-lobed.

Hooker (l. c.) recorded this species from "Khasia Mts., and Sikkim Himalaya (Griffith) and Ambagamowa Dt. in Ceylon (Thwaites)". Although Gamble (l.c.) stated that this plant occur in "Mysore at Cadamany (Barber) Anamalai Hills; Karianshola in dense evergreen forests at 2500 ft. (Fischer)", no representative collection of this species is available in MH and no collection from South India is available in CAL. The present collection from Boneccord in Trivandrum Dt. is its first report from Kerala.

Aphyllorchis montana (Thw.) Reichb. f. is closely allied to *A. prainii* Hook. f., and both of them are often treated as conspecific. Seidenfaden writes (on the Herbarium Sheet No. 171 of *A. prainii* Hook. f. collected by G. Craib and deposited at CAL): "I believe *A. prainii* to be conspecific with *A. montana*". *A. montana* is, however, distinct from *A. prainii* by the absence of the ovate, acute wing like auricles at the claw of the lip.

This plant is very rarely found in the shady undergrowth of the dense evergreen forest in moist humus enriched soil.

Specimens examined: ASSAM. Dasrung: Jaintia Hills, June 1899, *Dr. Prain* 304 (CAL). SIKKIM HIMALAYA. Suru Bathan, August 1894, *R. Pantling* 344 (CAL). KERALA. Trivandrum Dt.: Boneccord, 26-5-1979, *M. Mohanan* 63292 (MH).

Eulophia cullenii (Wight) Blume, Orch. Archip. Ind. 182. 1858, in Obs.; Radhakrishnan in Bull. bot. Surv. India 13: 3. 1971. *Cyrtopera cullenii* Wight, Icon. t. 1754. 1851. *Eulophia flava* (Lindl.) Hook. f. Fl. Brit. India 6: 7. 1890. *p. p. E. cullenii* (Wight) Fischer in Gamble Fl. Pres. Madras 1435. 1928.

Terrestrial herbs, up to 0.5 high; rhizome tuberous. Leaves up to 27 x 6 cm, oblong-lanceolate, acute appearing with the inflorescence. Flowers 5.5 cm long, bright yellow, in racemes up to 0.4 m long; bracts 1.5 x 0.3 — 0.5 cm, ovate- lanceolate, acuminate, yellow; pedicels 2.5 cm long. Dorsal sepals 3 cm long, narrowly lanceolate, acute; laterals up to 3.5 cm long, falcate, oblanceolate. Petals 2.5 x 1.5 cm, broadly ovate, clavate. Lip 3-lobed; lateral lobes up to 2 cm long, obtuse, falcate; midlobes 1 cm long tongue-shaped with 3 crests. Mentum conical; column 1.5 cm long, flat; stigma conical, oblique; pollinia two, jointed with a strap, granular.

This species is closely allied to *E. flava* (Lindl.) Hook. f. but differs by the mature leaves being larger in size and the absence of pyriform basal cali at the disc. Distinguishing the two species, Robert Wight *l.c.* writes, "I am indebted to General Cullen, Resident of Travancore, for my specimens of this gorgeous plant. It is nearly allied to *C. flava*, with which I at first confounded it. Like it the flowers are yellow and scape appears before the leaves, but the appearance of the plant so far as I can learn from the comparison with Dr. Royles figure is altogether different. On these grounds I have dedicated it to the discoverer, a zealous investigator of the plants of that tract of country but more especially of the economical application of the useful ones. This plant seems to be a large one some of the leaves being nearly 2 ft. in length."

This species is not so far represented in MH. The present collection is made during March from Pattampara, on the way to Agastyarkudam where a small population of it was seen in flower in the rocky regions of the grassy slopes. It was introduced in the experimental garden at Coimbatore but it failed to flower so far.

The valid publication of *E. cullenii* dates from Blume (1858) and the combination made afresh by Fischer (1928) is superfluous.

Specimens examined: KERALA. Trivandrum Dt.: Pattampara, 17.3.1978, *M. Mohanan* 54686 (MH).

Malaxis latifolia Sm. Rees. Cycl. 22: no. 3. 1819; Holttum in Revis. Fl. Malaya 1: 195. 1972 (repr. ed.); Seidenfaden & Smitinand in Orch. Thailand 2(1): 146. 1959. *Microstylis latifolia* J. J. Sm. Fl. Buit. 6: 248, f. 185. 1905. *M. congesta* Reichb. f. Walp. Ann. 6: 206. 1861; Hooker in Fl. Brit. India 5: 680. 1890; King & Pantl. in Ann. Roy. Bot. Gard. Calcutta 8: Pl. 23. 1898.

Terrestrial herbs; stems stout, 4-5 leaved. Leaves 14-27 x 7-8 cm, ovate-elliptic; petioles broad with a sheath of 3-4 cm long. Scape with raceme 20-25 cm long, stout. Flowers yellowish green, closely arranged; bracts up to 5 mm long; pedicels 3 mm long. Sepals curved inwards; dorsal 3-4 x 1 mm; laterals 3-4 x 1.5 mm, 3-nerved. Petals 4 x 0.5 mm; lip 2 x 2 mm, 3-lobed, side lobes broad and blunt. Column 0.9 mm long; anthers on the back of the column, pollinia 4.

Although Hooker recorded this plant from Deccan Peninsula no earlier collections from South India and elsewhere is represented in MH so far. The species was found rare in the undergrowth of dense evergreen forests of Boneccord.

This species is an addition to the Gamble's Fl. Pres. Madras and can be distinguished from the other South Indian species as follows:

1. Lip with auricles............... *M. acuminata*
1. Lip without auricles:
    2. Lip distinctly 3-lobed; lobes entire at apex .... *M. latifolia*
    2. Lip without distinct lobes, apex lacirate:
        3. Plants with pseudobulbs; leaves sessile. .... *M. densiflora*
        3. Plants without pseudobulbs; leaves petioled:
            4. Flowers less than 5 mm long; lip retuse in outline......... *M. versicolor*
            4. Flowers 7-10 mm long; lip semi-orbicular in outline...... *M. stocksii*

Specimens examined: ASSAM. N. Cachar Hills, 28.8.1908, *William G. Craib* 514 (CAL); Mizo hills, *R. M. Datta* 33268 (CAL); Ienkeri, July, 1859, *s. l.* 652 (CAL). BIHAR. Paraniatte, *s. l.* Acc. No. 449378 (CAL). KERALA. Trivandrum Dt.: Boneccord, 22-5-1979, *M. Mohanan* 63216 (MH). SIKKIM. Tropical valleys, July, 1892, *R. Pantling* 89 (CAL); "Namaga Ind."; Oct. 1886, *Dr. King's Collector* Acc. No. 449369 (CAL).

Botanical Survey of India,
Coimbatore-641 003,
September 26, 1980.

M. MOHANAN
A. N. HENRY
N. C. NAIR

37. CULTIVATION OF ENDANGERED PLANTS IN SOUTH INDIA — 2. *BENTINCKIA CONDAPANNA* BERRY EX ROXB.

(*With a plate*)

This note relates to a palm namely *B. condapanna* Berry ex Roxb. which is highly restricted and endemic to a few hills of Tamilnadu and Kerala in Western ghats.

B. condapanna Berry ex Roxb. commonly known as hill areca nut (Tam: Varekamugu, Tel: Cadapanna, Mal: Kanthal) (Gamble 1957, Sundararaj and Balasubramanyam 1959) belongs to the family Arecaceae (Palmae). The genus *Bentinckia* is named after Sir William Henry Cavendish Bentinck, ex Governor General of the East-Indies by Berry in Roxb. Fl. Ind. III, 621 (Hooker 1894). This genus is represented by 2 species in India namely *B. condapanna* Berry ex Roxb. and *B. nicobarica* (Kurz) Becc. (Hooker 1894). *B. condapanna* Berry ex Roxb. is a tall, slender, unbranched tree of about 30 feet appearing gregariously in certain cliffs of Western ghats in Tirunelveli, Kanyakumari and Madurai districts of Tamilnadu and Trivandrum district of Kerala (plate 1). These palms seem to like the western slopes particularly with some protection from sweep of direct wind. These have been located in Kakachi and Nalumukku cliffs on the way to Kodayar, in Perumal malai, Naterikal in Kalakkadu hills, Manjanamparai and western slopes of Agasthyamalai in an altitude range of 90-1350 Mts. F. Blasco (1971) states "Dans ces forets des vallees la flore S'enrichit, par rapport au type precedent en...........palmiers (*Bentinckia — condapanna* versant N. E. des Palni,......) ......etc." The detailed herbarium data in M. H., Coimbatore is furnished in table 1.

There has not been much information from the published records on cultivation of this species as an ornamental in any of the known Botanical gardens of India and abroad except at Peradeniya Gardens, Sri Lanka (Blatter, 1926). The terminal buds of these trees are reported to be edible (Gamble 1957).

Due to its highly restricted distribution and non-occurrence of this palm in any other part of the country or abroad this has been declared highly endangered (Jain and Sashtri 1980).

The experimental garden of the Botanical Survey of India, Southern Circle, Yercaud brought saplings of this species from natural habitat from time to time since 1974 and introduced in rock crevices particularly facing west almost simulating natural habitat, but they failed to establish. In the year 1977 again 6 plants were obtained from collections of Dr. A. N. Henry and further trials were made at Yercaud. They were introduced in different places after acclamatizing in pots in nursery for nearly one year. The first planting made in September, 1978 in a shady rocky area on the slope facing west did not establish inspite of all care. In October, 1978 two other plants in stock with almost similar size were put into deep pits of 4′ x 4′ in rich humus soil with plenty of shade above. Regular watering, digging, weeding etc were attended. Though one plant showed inhibition in growth, another grew better with healthy leaves and good spread (plate). 2 other in pots have also been healthy though stunted in growth. These have since been planted in suitable locality during the current rainy season. The measurements of the first two plants in beds in given in table-2 to indicate the growth behaviour in this clima-

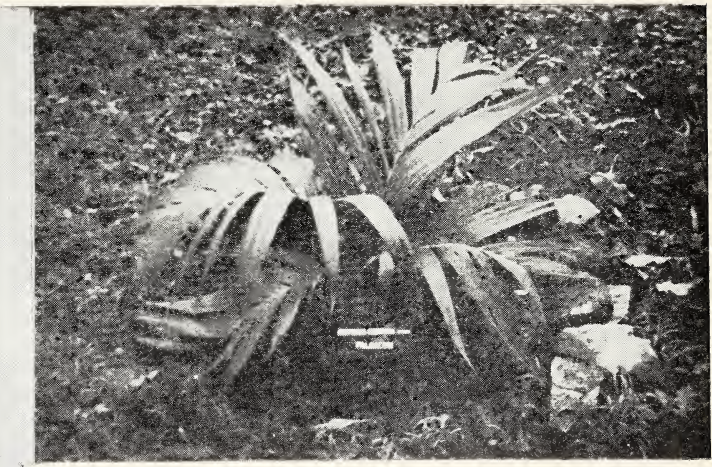
TABLE 1

Field No.	Date	Place of collection.	Collected by	Remarks.
52652	4.3.1917.	Near Neterikal, Tirunelveli Dt., T.N.		....
16383	30.5.1963.	Manjanamparai, Tirunelveli Dt., T.N.	A. N. Henry.	Pinkish red flowers.
1039	28.8.1967.	Perumalmalai, Madurai Dt., T.N.	Thanikaimani.	Fruits red, smooth and speroidol when fresh, Immature fruits contains a central cavity filled with a waxy sap.
44639	6.10.1973.	Western slope of Agastyamalai, Trivandrum Dt., Kerala.	J. Joseph.	Spadix arising from the axils of fallen leaves below the crown; flowers pinkish red; fruits ovate globose, bright chocolate coloured.
49651	7.8.1977.	Way to valve house, upper Kodayar, Kanyakumari Dt. T.N.	A. N. Henry.	Tall tree, ± 20 mt. high on rocky slopes, fruits red, pinkish red, very common.
73126	....	Kalakkadu hills, Tirunelveli Dt., T.N.	....	

TABLE 2

MEASUREMENTS RECORDED AS ON 15-7-1980

Plant No.	Height of the Shoot.	Girth of the plant at ground level.	No. of leaves	Length & Breadth of the largest leaf. (L x B)
1.	26 Cms.	22 Cms.	8	1.3 x 0.75 M
2.	10 Cms.	10 Cms.	6	0.65 x 0.26 M



Above: The plant in Experimental Garden, Yercaud.
Left: *Bentinckia condapanna* Berry ex Roxb. in natural habitat.

tic condition. Further observation on the growth cycle of these plants are being recorded.

ACKNOWLEDGEMENTS

We are thankful to Dr. N. C. Nair, Deputy Director and Dr. A. N. Henry, Regional Botanist, Botanical Survey of India, Sauthern Circle, Coimbatore-3 for their kind encouragement during the course of this work.

BOTANICAL SURVEY OF INDIA.
SOUTHERN CIRCLE,
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TAMILNADU- 636 601,
August 14, 1980.

A. V. N. RAO
A. K. BANERJEE[1]

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ERRATA

Corrections to the "Seasonality and Occurrence of Birds in the Eastern Ghats of Andhra Pradesh" Vol. 76 (3) 1979 pp. 379-422.

p. 402 The figure caption refers to the figures on pp. 400-401. The figure on p. 402 should be accompanied by the caption: Fig. 14 The percentage of recaptures in the total summed catch over each three week period.

p. 418 The description given for the Orangeheaded ground thrush refers to the Whitethroated ground thrush, *Zoothera citrina cyanotus*. The orangeheaded ground thrush's description was omitted and is given here:

Orangeheaded ground thrush, *Zoothera citrina citrina.* Records for the 30th September, the 11th, 25th and 28th October and the 4th May. Passage migrant.

I thank Humayun Abdulali for pointing out this last omission.

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TERRITORIAL BEHAVIOUR OF THE INDIAN BLACKBUCK (*ANTILOPE CERVICAPRA*, LINNAEUS, 1758) IN THE VELAVADAR NATIONAL PARK, GUJARAT[1]

M. K. Ranjitsinh[2]

(*With three plates and a text-figure*)

The word 'lek' is of Scandinavian origin meaning play. In ethology the word has come to denote restricted territories occupied and intensively used by breeding males for display and mating. Blackbuck territories are of various sizes. In Mudmal, Andhra Pradesh, Rao & Prasad (1982) found the average territory to be of 9.19 hectares. In Kanha, National Park in Madhya Pradesh, Schaller (1967) found the territory to be of 8.09 hectares.

Blackbuck also maintain small, round or oval territorial breeding grounds which bear close affinity in character and purpose to similar grounds of the Uganda Kob (*Adenota kob thomasi* Sclater, 1896), and which in turn are conceptually similar to the 'leks' of the prairie chicken (*Tympanuchus cupido*), sage grouse (*Centrocercus urophasianus*), sharp-tailed grouse (*Pedioecetus phasianellus*), Gould's manakin (*Manacus vitellinus*) and others (Buechner 1974). For purposes of convenience these territorial breeding grounds of blackbuck would be also referred to as leks. These leks, however, were only observed in the Velavadar National Park, for only here were the territories small, precisely defined, in close proximity of each other and occupied for a length of time. As in the case of the leks of the Uganda Kob seen by the author at Karuma Falls in Uganda (1964), the blackbuck leks bore the marks of overusage through grazing and pacing in a very restricted area and were identifiable from the surrounding grassland by the less vegetation they bore. These small territories are called 'akhlis' in the Gujarati language.

Blackbuck achieve territorial marking and delineation in several ways. Firstly, with his strikingly black and white colour scheme and spectacular horns, the most conspicuous territorial marker is the presence of the male himself on his territory (Schaller 1967). As sexual activity, of which territoriality is a manifestation, enhances the testosterone production

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which in turn causes, in all probability, the darkening of the coat (Mungall 1978) the darker coat of a territorial buck would in all probability enhance his ability to pronounce his territory and to retain it. It was no coincidence that all territorial males observed in this lek ground (January 1981) December 1981 were all black or dark chocolate brown.

Another important territorial marking are the pellet piles in certain selected spots. In the larger territories which blackbuck usually maintain, including those that have a recognizable core, the pellets were deposited in a number of strategic points along the periphery. In the leks of Velavadar which are very small, the pellet heaps were in approximately the middle of the leks. The pellet deposition is almost invariably immediately preceded by urination and since the blackbuck usually sits upon these sites, the purpose of selecting such sites for bedding is therefore, in all probability, to acquire scent on the coat. The Great Indian one-horned rhinoceros urinates in its wallows whose purpose, in all probability, is to acquire scent on its body (Laurie 1978). It is likely that blackbuck too has a similar objective, and it is possible that scent excreted with either the dung or the urine is from an anal or urinary scent gland and has olfactory sexual significance.

These excreta cum bedding sites normally command a good vantage point for observation. ' Lindy ' my tame blackbuck also rested on these excreta sites.

Close to the excreta-cum-resting sites, scrapes were seen and these also perhaps are visual territorial markings, especially in areas of short grass and on the Ranns and tals of arid western India. These scrapes were also observed in the leks of Velavadar. Lindy scraped persistently, but this exaggeration of this particular behaviour may have been caused by the fact that he was frequently tied with a long rope and could not go beyond a certain point where he scraped, especially when someone was approaching him. Scraping was also observed when a territorial buck was in the vicinity of another. Scrapes by the dragging of feet was never noticed.

Scraping is also done prior to urination and deposition of pellets, frequently preceded by a sniffing of the dung pile (Schaller 1967). Territorial males were also observed to scrape their dung piles, on four occasions, before depositing pellets on those dung piles. Scraping prior to pellet deposition, however, was not observed outside the leks. One communal pellet pile measuring almost 2 metres by 1.60 metres, however, did have scrape markings on it.

Another olfactory marking consisting of wiping of the secretion of the preorbital glands on prominent reeds, twigs and grasses, and occasionally by rubbing the glands against tree trunks and leaves.

Lindy, my tame blackbuck, practised this regularly. The strong-smelling secretion left a distinct smell that was discernible for upto 3 days in dry weather. The deposition of the scent of the pre-orbital glands was noticed to be more frequent amongst solitary males and male-pairs than with either the mixed herd males or with members of male groups.

In Velavadar where the only vegetation where such markings could have been made was the thorny *Prosopis juliflora* and these too do not occur in the close vicinity of the leks, such markings with everted eyeglands on *Prosopis* saplings was observed only 7 times.

To the east of Velavadar village and at the edge of the National Park of the same name, is the tourist lodge. South of that is a water trough and beyond it is a kidney shaped area where a conglomeration of adjacent leks or territorial grounds occupied by 48 to 52 males, with 5 more semi-transient males on the southern periphery of this area (Fig. 1), observed in January 1981.

The explanation for all the leks being on the south side of the water trough only, appears to be that with the Velavadar village being to the west and a cart track being to the north of the water-trough, the main approach of the blackbuck herds to the water is from the east and the south. The cart track would also constitute a source of disturbance to any leks if they had happened to be established there. The southern side is more preferred because the antelope returning from the fields and going to it from the park pass through that flank. It was also observed that in areas of high antelope concentration and where the open even terrain precludes precise marking of boundaries as in the case of the Velavadar National Park, blackbuck male territories are most evident in close juxtaposition around a focal point of attraction, such as a source of water or food, rather than scattered all over the terrain, and constitutes a lek ground.

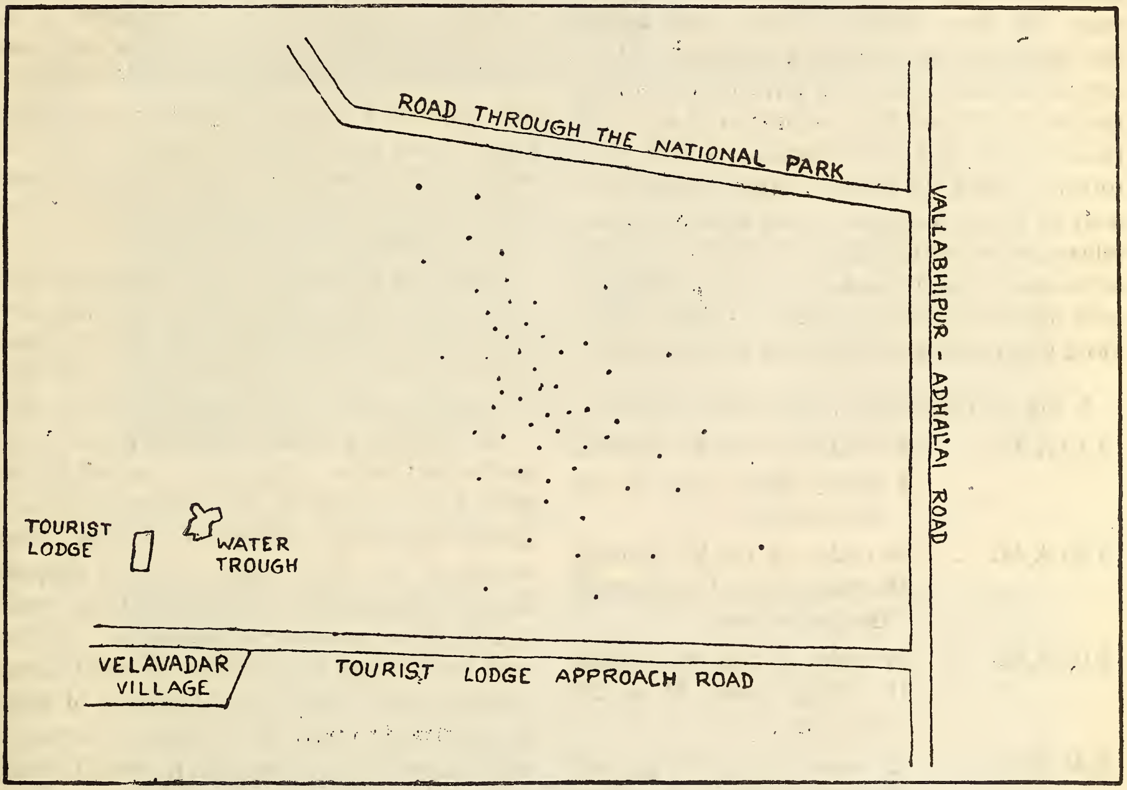

ROAD THROUGH THE NATIONAL PARK
VALLABHIPUR - ADHALAI ROAD
TOURIST LODGE
WATER TROUGH
VELAVADAR VILLAGE
TOURIST LODGE APPROACH ROAD

Fig. 1. Diagram showing the appropriate position of Territories.

The Velavadar lek area measured 680 metres by 430 metres, but the main ground of concentration, which was approximately at the core of the kidney shaped area, was 380 metres by 290 metres and comprised of 30 leks. The smallest lek was just 28 metres by 24 metres. These leks in the prime core area were smaller than the others, and the occupants remained seated in them for longer periods than in the others. They occupied them earlier in the morning and left them later in the evening, and consequently these territorial males in the prime area of the lek ground grazed less. They also moved about the least in their circumscribed territories.

The males in the core area usually occupied their territories within 20 minutes of sunrise, most of them before sunrise, and started leaving them a few minutes after sunset. Upon arrival on their respective territories at dawn, the males sit upon their territories in an act of reoccupation and reconfirmation of their territories. About 20 minutes after sunrise they start to get up and graze, and their is a slight relaxation of territoriality in so far as the males often stray close to each other and trespass on each other's territories. Later on they sit once more upon their territories and become insular.

A log of their day's movements (15/1/81)

7.10 A.M. ..	44 males on the lek ground. 8 sitting down, 7 all in the prime area.
7.40 A.M. ..	46 males on the lek ground. 26 sitting down, 17 of them in the prime area.
8.05 A.M. ..	48 males on the lek ground. 31 sitting down, 24 in the prime area.
8.45 A.M. ..	52 males on the lek ground. 39 sitting down, 29 in the prime area.
11.05 A.M. ..	54 males in the lek ground. 48 sitting down, 29 in the prime area.
3.15 P.M. ..	52 males on the lek ground. 46 sitting down, 28 in the prime area.
6.30 P.M. ..	47 males on the lek ground. 34 sitting down, 23 in the prime area.
7.00 P.M. ..	2 males standing and eating on the lek ground.

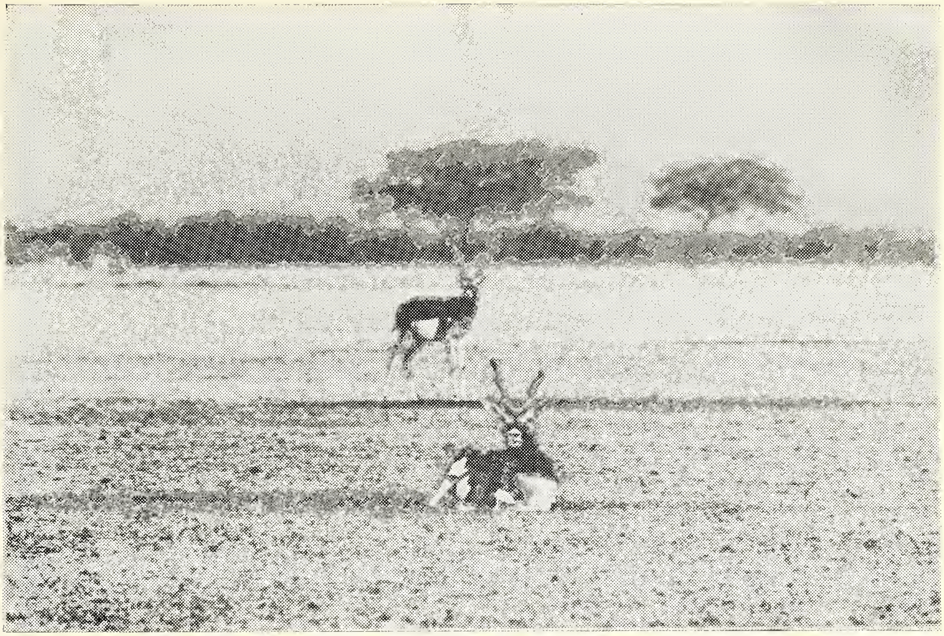
In the moonlight after 9 P.M. there were no blackbuck to be seen on the lek ground.

600 metres away from the lek ground was the preferred resting ground of the largest all-male group, which in fact was a loose association of smaller groups of males the total strength of which varied from about 77 to 160 males. All barring 8 to 10 per cent were mature males. They sat in close proximity of each other and the only agnostic interactions noticed were two sparring matches, each not lasting over 40 seconds. These large all male groups often have cores, usually of males of the same age group.

On the lek ground the males usually sat with their backs to the wind, facing the winter sun. Frequently, they stretched out and lay their heads on the ground in the front, and often tilted their heads to rest a horn on the ground.

The lengthy periods of sitting down in the smaller territories in the prime area of the lek ground not only serves the purpose of giving a greater territorial possessivity to the male occupant, but also helps to avert frequent agnostic interactions between territorial males in such close proximity of each other. In fact, such interactions and displays occurred almost invariably only when other blackbuck of either sex happened to pass by, or when the territorial males happened to leave their grounds to drink or to feed. When a group of 11 males filed past the lek ground, the nearest territorial males on the lek ground approached the group with the head-up-ears-down display, head and horns bobbing in rythmic jerks, and the animals emitting the grunt-call. Some of the members of the all-male group broke into a slow trot while the others walked hurriedly past.

The territorial males that had to vacate their territories due to the proximity of my vehicle and had to enter their neighbour's, often ended up by jousting with the others. The combatants would then disengage, often struck parallel to each other, and then the interloper would



Male with both horns broken occupying a lek, with another territorial male in an adjacent lek. Note the dark patches showing the pellet piles.

All-male group on its preferred resting ground, the individuals sitting in close proximity of each other.

(*Photos :* Author)

Territorial males on the lek ground.

Males of adjacent leks sparring. Other territorial males occupying their leks in the background.

(*Photos :* Author)

Non-territorial males of the all-male group resting in close proximity of each other.

A fine specimen on its pellet pile, reluctant to leave its lek. Another territorial male in the background.

(*Photos :* Author)

veer away and attempt to return to his own territory. The owner of the territory would stand for a while displaying with head up and pre-orbital glands everted, and then return to the middle of his territory to sit down again. In some instances one or both combatants stamped their forefeet.

Two males, each with both broken horns of about equal length, and one with stumps only 18 cm long, were occupying territories in the prime area of the lek ground, jousted with others with undamaged horns, and were obviously able to hold adjacent prime territories. The former male, easily recognizable was found in a mixed group 11 months later (December 1981). On the other hand, a male with one large horn measuring about 57 cm but the other broken off at root, was only holding a tenuous territory on the extreme western periphery. In December, 1981 a single-horned male was again occupying a peripheral lek.

The mixed and larger female groups with adult males seemed to prefer not to go through the lek area, and when they did so, they tended to skirt past the periphery, with the adult males keeping to the side of the herd nearer to the lek area, the males in which were strutting and pacing about as the herd passed. When a transient male traversed the lek ground the agnostic behaviour displayed by the territorial males was less pronounced.

In the absence of any vegetation on the lek ground, the principal form of redirected aggression noticed was thrashing of the ground with legs spreadeagled but stationary, horns parallel and lowered to the ground, the head moving in a vigorous half-circular motion. On some occasions *Prosopis* sapling were also thrashed in the adjacent areas.

When a pack of three pidogs—which are a veritable scourge of the blackbuck-caused some female blackbuck to run into the lek ground, the territorial males chased them and attempted to court them through display, even though the rampaging dogs were within 70 metres, and the males were most reluctant to leave their territories even when the dogs were running past them.

On some occasions territorial males, when approached, showed extreme reluctance to leave their territories. They stood up from where they were sitting on their pellet piles, but stood their grounds, straddling over their pellet piles in a characteristic stand-stance, with front legs close together and the hind legs spread-eagled, and head slightly upraised.

In mid July (1981) there were no territorial males on the lek ground, which in fact was the least frequented area by the blackbuck as the forage on this ground, predictably, was the poorest due to overusage during the rutting period. By way of contrast, the usual resting place of the largest all-male group during the peak rutting period—to the north-east of the Velavadar rest house—continued to be occupied by the all-male group in July. An all-male group of 82 to 86 animals, again the largest all-male group in the park, albeit fawn-coloured now, continued to rest on this same patch. The old pellet piles on the lek ground, however, contained only old pellets with no fresh depositions.

In December 1981 the lek ground as well as the preferred resting area of the largest all-male group were found to be the same as in January, 1981. On the basis of observations made during six winters the peak winter rutting period in Velavadar was found to be January-February.

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SOME POST-MONSOON BIRDS OBSERVED IN CENTRAL NEPAL[1]

PAUL HENDRICKS[2]

Though Pokhara, and the surrounding terrain in Gandaki Anchal, is one of the more readily accessible regions in Nepal, surprisingly little information has been published on the avifauna of that area. Woodcock and Woodcock (1976) provided information on monsoon season (July and August) birds. They expressed hope that their account would stimulate others to keep records on the birds encountered in the same area, particularly during other seasons. It is for this reason that I present the following observations. They were made during the post-monsoon season between 17 October and 30 December, 1974 while I was stationed at Batulechar 3 km. N of Pokhara with the U.S. Peace Corps program. I have also included species observed on a short trek from Bandipur to Bharatpur, SE of Pokhara and in the same watershed, in December. All observations were made below 2000 m. For a general description of the vegetation and physiography of the region see Biswas (1966). Identification of species encountered was originally based on accounts in Ali (1949, 1972). Subsequently these have been correlated to accounts in Fleming *et al.* (1976), whose common and scientific nomenclature I use in this paper.

Woodcock and Woodcock (op.cit.) listed 107 species from the Pokhara region to which I have added 36 species not reported in their paper. Lists of species in themselves are of limited value, but when the data are combined, particularly if it has been collected during different times of the year in the same area, then some conclusions on the seasonal presence, abundance, and movements of species can be made. With this in mind I have compared my notes with species reported from Kathmandu Valley (KV) by Proud (1949, 1952, 1955, 1958, 1961a, 1961b), and with the list of Pokhara area birds by Woodcock and Woodcock (op. cit.), hereafter abbreviated WW when referred to. Though my list of post-monsoon birds is not comprehensive it never-the-less provides a nucleus of data with which future, more detailed, work can be compared. Considering the rapid deforestation of Nepal (Eckholm 1975 ; Cronin 1979), and the associated ecological problems created, this kind of information is urgently needed if any future management plan is to be intelligently implemented. Additionally, I have included brief notes on behaviour and ecology where appropriate.

I thank Jon Swenson for useful suggestions and encouragement on the manuscript.

Ardeola grayii Pond Heron

Seen around Bharatpur 18 December ; a group of 10 perched and preening atop a bamboo grove in Batulechar 23 December. Not seen around Pokhara by WW ; considered abundant year round in KV (Proud 1949).

Bubulcus ibis Cattle Egret

Common in fields with cattle around Bharatpur on 17 December.

Ciconia episcopus White-necked Stork

Batulechar ; on 4 December a flock of 24 flying slowly from N to S. On 11 December a single bird flying in wide circles over the village. Not seen by WW ; occasional year round in KV (Proud 1949).

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Mergus merganser Merganser

On Seti river S of Bandipur ; a flight of 7 followed by a flight of 5 headed upriver on 16 December. All were females.

Milvus migrans Dark Kite

Common at Pokhara ; less so at Batulechar, single birds being seen there on 4, 21, 24, 29 Nov., and 23 Dec. Concentrates at centers of human habitation.

Buteo buteo Eurasian Buteo

Regularly seen at Pokhara and Batulechar between 9 Nov. and 24 Dec. Single birds usually riding updrafts over the river gorges or cliffs, sometimes in the company of vultures. Not seen by WW ; apparently a winter visitor.

Torgos calvus Black Vulture

Batulechar ; on 19 Nov. 3 birds soaring over the river gorge in company with 2 Egyptian Vultures. Fairly common year round in KV (Proud 1949) less so around Pokhara.

Gyps bengalensis Whitebacked Vulture

Batulechar ; on 6 Nov. one flushed from a dead cow when approached within 20 m. On 25 Dec. several soaring over the river gorge near the village. Considered the common vulture in KV (Proud 1949).

Neophron percnopterus Egyptian Vulture

Common at Pokhara, less common at Batulechar. Usually single birds soaring within 100 m. off the ground. One observed preening its breast plumage while gliding over the river gorge near Batulechar. Surprisingly, Proud (1949, 1952, 1955) did not see this species in KV, suggesting this species has expanded its range into this region within the last 25 years.

Falco tinnunculus Eurasian Kestrel

Seen infrequently near Pokhara. Single birds noted on 17, 25 Oct., 14, 16, and 25 Dec. A winter visitor in KV (Proud 1949, 1955) ; seen by WW around Pokhara in summer.

Vanellus spinosus Spurwinged Lapwing

On 16 Dec. 2 individuals were seen on the sandy beaches along the Seti river S of Bandipur. A 3 sec flight chase ensued when the first bird flew by the second. Not mentioned by WW nor by Proud (1949, 1952, 1955).

Calidris temminckii Temminck's Stint

Two seen on the river bank on 17 Dec. near Bharatpur. A winter visitor (Proud 1955).

Sterna aurantia Indian River Tern

Many over flooded paddies outside of Bharatpur on 17 Dec.

Columba livia Blue Rock Pigeon

Common around Pokhara.

Psittacula cyanocephala Blossom-headed Parakeet

On 17 Dec. a flock of 20 flew in a tight group out of a wooded area and over millet fields S of Bharatpur. Both sexes present.

Psittacula himalayana Slaty-headed Parakeet

Batulechar ; on 3 Nov. a flock of 15 flying into a dense grove of trees silently. Appeared to be all males. Not seen by WW ; a winter visitor in KV (Proud 1955).

Bubo bubo Great Horned Owl

Seen at dusk 22, 24 Oct., and 9 Nov. near Pokhara on the cliffs above the Seti river. Heard hooting several times. Not mentioned by Proud (1949, 1952, 1955) nor WW.

Glaucidium cuculoides Barred Owlet

Batulechar ; one seen perched 4 m above a trail mid-morning on 25 Dec. A common and diurnal species around KV (Proud 1955), not seen by WW.

Caprimulgus macrurus Longtailed Nightjar

Batulechar; on 12 Dec. one heard calling irregularly from 1945-2015, one call every 7 sec/series of calls. Heard by Proud (1949) in KV but not earlier than mid-March.

Coracias benghalensis Indian Roller

Seen daily at Batulechar; usually single birds and some pairs observed on same perches each day, making sallies to the ground to catch insects. Daily occurrence at same perches suggests the possibility of winter territorial behaviour, though no agonistic encounters were observed. Fairly common in forested areas around KV but not in the valley itself (Proud 1955, 1961a).

Ceryle lugubris Large Pied Kingfisher

Batulechar; one seen along a clear water river on 25 Dec. Since kingfishers hunt their prey by sight their occurrence along rivers carrying large quantities of suspended glacial sediments would not be expected. Not seen by WW.

Alcedo atthis Eurasian Kingfisher

Batulechar; on 16 Nov. one seen on a clear water river. It flew from a bank-side perch and hovered 5 m over the water for 2-3 sec. before diving and catching a fish which it carried off. Year round resident in small numbers in KV (Proud 1949); not seen by WW.

Megalaima asiatica Bluethroated Barbet

Batulechar; seen on 2, 4, and 12 Dec. Sunning in the early morning atop a bamboo grove with drongos, mynas, and Himalayan Tree Pies; 4-5 foraging with a group of Yellow-cheeked Tits. Year round resident in the hill regions (Proud 1949; WW).

Megalaima haemacephala Crimsonbreasted Barbet

Batulechar; one seen on 11 Dec. sunning and preening in the early morning atop a bamboo grove. Heard by WW; considered a monsoon visitor to KV (Proud 1949).

Chrysocolaptes lucidus Large Golden-backed Woodpecker

One male seen in open oak forest several km N of Bharatpur on 16 Dec.

Dendrocopos macei Fulvous-breasted Pied Woodpecker

Batulechar; a female seen in the same area on 6, 12, and 13 Dec. On 15 Dec. a pair was seen along the Seti river S of Bandipur. Not seen by WW; common in KV (Proud 1949).

Apus affinis House Swift

Roosts under the roofs of houses in Pokhara and seen frequently hunting over the city and nearby river gorge until Nov.

Hirundo rustica Barn Swallow

Seen regularly around Pokhara until Dec.

Hirundo daurica Striated Swallow

Seen regularly around Pokhara until Nov.

Lanius schach Blackheaded Shrike

Batulechar; seen 23 Oct., 9, 11, and 23 Dec. Usually perched atop a bush hunting ground-dwelling insects. One seen in company with 2 mynas. Year round resident (Proud 1949; WW).

Oriolus xanthornus Blackheaded Oriole

One seen feeding with a group of Scarlet Minivets atop 20 m tall trees along the Seti river S of Bandipur on 15 Dec.

Dicrurus leucophaeus Ashy Drongo

Batulechar; several usually in association with Black Drongos during Dec. The behaviour of the two species is similar. Not seen around Pokhara in summer but found at higher elevations (WW). Seems to move to lower and more open habitats in winter (Proud 1949).

Dicrurus adsimilis Black Drongo

Batulechar ; seen regularly each morning sunning and preening atop a bamboo grove. Group varied in size from 4-20. Other morning tree-top associates included Ashy Drongo, Jungle Myna, Common Myna, Blue-throated Barbet, Red-vented Bulbul, Himalayan Tree Pie, and Jungle Crow. One crow was mobbed by several drongos when it departed the bamboos. Intraspecific flight chases were common ; some individuals made sallies from the bamboo to the ground and back once warmed up (about 0700). Individuals dispersed during the day in smaller groups. Common year round (Proud 1949 ; WW).

Sturnus contra Pied Myna

One seen on 17 Dec. in Bharatpur.

Acridotheres tristis Common Myna

Seen daily in Batulechar, usually in the company of Jungle Mynas. Both species roosted together in a nearby bamboo grove, becoming active and vocal with first light (0600-0630). Evening roosts began to form at 1800 accompanied by noisy chatter. In early morning, after sunning, flocks dispersed in groups of 20-30 individuals/flock. Flocks usually were composed of conspecifics only, though both species foraged together.

Acridotheres fuscus Jungle Myna

Seen daily in Batulechar. Exhibits more variation in seasonal abundance than the former species (Proud 1949). For additional notes see the previous account.

Cissa erythrorhyncha Red-billed Blue Magpie

Batulechar ; seen infrequently. A group of 3 appeared in the same area 15 and 17 Nov., and 27 Dec., making a series of short flights from tree to tree. Not seen by WW ; considered very common in KV (Proud 1949).

Dendrocitta formosae Himalayan Tree Pie

Seen regularly at Batulechar during Dec. Usually single birds or pairs sunning in the early morning atop a bamboo grove favoured by mynas and drongos. Inhabits higher elevations in the summer (WW), wintering at lower elevations in the hills (Proud 1949).

Corvus splendens House Crow

Common at Pokhara, less frequently seen at Batulechar where sightings included a flock of 30 flying by on 1 Dec., one bird perched atop a bamboo grove on 9 Dec., and one bird passing through the village on 28 Dec.

Corvus macrorhynchos Jungle Crow

Seen daily in Batulechar, sometimes in groups of 10-15 individuals. Several seen mobbing a hawk 5 Dec. More rural in distribution and abundance than the former species (Proud 1949 ; WW).

Pericrocotus flammeus Scarlet Minivet

Batulechar ; a female was seen on 9 Dec. hunting insects from a low tree limb ; on 15 Dec. a group of 8 (equal sexes) foraging through tree crowns along the Seti river S of Bandipur, accompanied by one Black-headed Oriole. Not seen by WW.

Pycnonotus melanicterus Blackheaded Yellow Bulbul

One low in a tree near Bandipur on 14 Dec. Not seen by WW.

Pycnonotus cafer Redvented Bulbul

Batulechar ; seen daily in Dec. beginning with one bird on 2 Dec. and increasing to a group of 20 by 13 Dec. Usually sunning atop trees in the early morning with several other species. Flocks usually foraged low in trees or shrubs. Common in the summer (WW).

Leiothrix argentauris Silvereared Mesia

A group of 7-8 foraging in shrubs and trees above the Seti river S of Bandipur, hanging from thin branches in the early morning (0700) on 16 Dec. Accompanied by a White-throated Fantail Flycatcher. Not seen by WW.

Rhipidura hypoxantha Yellowbellied Fantail Flycatcher

Batulechar ; one low in a tree at forest-field edge on 25 Dec. A common winter resident in KV (Proud 1949, 1955, 1958), moving to higher elevations to breed.

Rhipidura albicollis Whitethroated Fantail Flycatcher

On 16 Dec. one in the company of a group of Silver-eared Mesias above the Seti river S of Bandipur. An uncommon winter visitor in KV (Proud 1952).

Culicicapa ceylonensis Grayheaded Flycatcher

Batulechar ; one seen on 6, 7, and 26 Dec. chattering constantly and flicking its tail, making short sallies from a twig perch at the forest-field edge, catching aerial insects. Common at higher elevations during summer (WW) ; usually leaves KV by Nov. (Proud 1955).

Erithacus pectoralis Himalayan Rubythroat

Batulechar ; one male seen in dense undergrowth in woods on 25 Dec. A winter migrant in KV (Proud 1955).

Erithacus brunneus Blue Chat

Batulechar ; a female on a forest lined trail on 7 Dec., a female seen in similar habitat on 10 Dec. Appears to be a winter visitor, breeding at higher elevations (Proud 1955).

Copsychus saularis Magpie Robin

Batulechar ; both sexes seen frequently, usually in low shrubs and undergrowth along hedges. Males singing early in the morning (0700) in Dec. ; some birds appeared to be paired and may have had winter territories, since they were seen in the same places daily. Never more than 2 birds (one male and one female) were seen together. Surprisingly, WW did not report this species for the Pokhara area though they did see it in KV. Proud (1949) found it common year round in KV. She did not report mid-winter song, but reported pairs remained territorial.

Chaimarrornis leucocephalus Whitecapped River Chat

Batulechar ; common along the rivers hunting insects low over the water surface, moving from boulder to boulder while rapidly pumping the tail. Seen within 2 m of conspecifics, Plumbeous Redstarts, and Brown Dippers without agonistic behavior shown. A winter visitor (Proud 1949), not seen by WW.

Rhyacornis fuliginosus Plumbeous Redstart

Batulechar ; seen more frequently than the previous species in the same riverine habitat. Hunting behaviour of the two species also similar. Most individuals seen were males, who wagged and fanned their tails as they sang from river boulders. Only single birds were encountered. Common in summer (WW) ; Proud (1949) considered it common year round in KV.

Saxicola caprata Pied Bush Chat

Batulechar ; one male perched on an electric line near woods on 8 Dec. After remaining stationary for 5-6 min. it began hawking insects.

Zoothera dauma Speckled Mountain Thrush

One seen in Batulechar on 3 Dec. in low dense brush. Several individuals in similar habitat around Bharatpur. Seen by WW in the summer near Pokhara ; usually a winter visitor in KV (Proud 1955).

Myiophoneus caeruleus Whistling Thrush

One seen in Batulechar along a river on 2 Dec. As it moved amongst rocks it paused several times to slowly stretch and bow its body as it raised its tail, spreading the retrices, then slowly lowering the tail again. The bird appeared to be alone. A year round resident (WW).

Cinclus pallasii Brown Dipper

Seen infrequently only along clear water rivers around Batulechar. Most observations were of lone birds, but a pair was seen on 10 Nov. Both birds moved together. Dippers are territorial, and intolerant of conspecifics except during the breeding season, which begins in Dec. (Sunquist 1976) or Jan. (Fleming *et al.* 1976). Fledglings have been seen in Feb. (Proud 1955). Two birds together in Nov. suggests that pairing may occur earlier than previously reported. Distribution of this species is probably restricted to clear water since it hunts aquatic prey by sight and its prey base is sensitive to sediment load. Not seen by WW.

Parus major Gray Tit

On 16 Dec. a group foraging in trees and shrubs along the Seti river S of Bandipur. Several foraging with Yellowcheeked Tits in Batulechar on 26 Dec.

Parus xanthogenys Yellowcheeked Tit

Batulechar ; common in Dec., usually in company of other species, foraging in open stands of trees and shrubs.

Sitta castanea Chestnutbellied Nuthatch

Noisy group of 8-10 moving through a patch of woods S of Bandipur on 15 Dec. Considered common by Proud (1949) in KV ; not seen in the Pokhara area by WW.

Anthus novaeseelandiae Paddyfield Pipit

Batulechar ; common in Dec., usually in fields in flocks of 6-15 birds. A winter visitor in KV (Proud 1961b).

Motacilla flava Yellow Wagtail

One seen in Pokhara on 25 Oct. in a grassy meadow. A winter visitor (Proud 1955).

Motacilla caspica Gray Wagtail

Batulechar ; seen infrequently along rivers in Nov. and Dec. Only single birds noted. A winter visitor (Proud 1955).

Motacilla citreola Yellowheaded Wagtail

Batulechar ; one seen along a river on 7 Nov. A winter visitor (Proud 1955).

Motacilla alba Pied Wagtail

Seen regularly around Batulechar, usually in grassy meadows but also along river bottoms. Mostly single birds, but pairs and one group of 3 noted. The most abundant wintering wagtail in the Pokhara area and KV (Proud 1949).

Aethopyga siparaja Scarletbreasted Sunbird

Batulechar ; an adult male visiting poinsetta flowers on 28 Nov. Single males visiting poinsettas on 4 and 22 Dec. Both of these birds were molting head plumage, with the brilliant red feathers of the head and breast present in small patches. Proud (1949) considered it scarce in KV in spring and fall, and did not see it in summer or winter. Not seen by WW.

Passer domesticus House Sparrow

Seen daily in Batulechar, but usually only a pair or small group within a large flock of Tree Sparrows. Proud (1949) considered it a scarce summer visitor in KV. It appears to have become established in small numbers in many places since then.

Passer montanus Tree Sparrow

Batulechar ; common in flocks, which roost under roofs of houses. Much more abundant than House Sparrows. Abundant in KV (Proud 1949).

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BIOLOGY AND MORPHOLOGY OF IMMATURE STAGES OF *BRACON BREVICORNIS* (HYMENOPTERA : BRACONIDAE) AN IMPORTANT BIOLOGICAL CONTROL AGENT OF THE BLACK-HEADED CATERPILLAR PEST OF COCONUT[1]

V. V. Sudheendrakumar, U. V. K. Mohamed,
T. C. Narendran and U. C. Abdurahiman[2]

(*With fifteen text-figures*)

Bracon brevicornis (Braconidae : Hymenoptera) is one of the important biological control agents of *Nephantis serinopa,* the black headed caterpillar pest of coconut. An account of the biology and morphology of the immature stages of this parasitic wasp is given. There are five larval instars and the duration of development from egg to adult takes about 7-8.5 days.

INTRODUCTION

Bracon brevicornis (Hymenoptera : Braconidae) is one of the important biological control agents of *Nephantis serinopa*, the black-headed caterpillar pest of coconut in S. India. Though information on the biology of this parasitic wasp is available (Cheriyan 1928 ; Ramachandra Rao *et al.* 1948 ; Nirula 1955) no detailed studies have been made on the biology and morphology of its immature stages, hence the present study has been undertaken.

MATERIALS AND METHODS

In the laboratory *Corcyra cephalonica* S. was used as the host for rearing the parasite. Observations on the immature stages were done under Leitz Wetzlar Ortholux and Bausch & Lomb Stereozoom microscopes. Measurements of immature stages were taken using ocular micrometer. For the study of mouth parts, larvae were mounted in gum chloral. The diagrams were drawn by using camera lucida. The larval instars are determined by measuring the size of the mandibles as well as the diameter of the first thoracic spiracle which varies from instar to instar.

OBSERVATIONS AND RESULTS

DESCRIPTION OF LIFE STAGES :

Egg (Fig. 1)

Freshly laid egg is typically hymenopteriform and measures 0.40 to 0.55 mm in length and 0.13 to 0.15 mm in width. It is translucent and milky whitish in colour. Chorion is smooth, shiny and devoid of any sculpturing. It contains little yolk when laid and it occupies the entire area within the chorion leaving only a little space.

Hatching

The incubation period varies from 24-28 hours. When the egg is approximately twenty hours old, developing larva is visible through the transparent chorion. A wriggling movement of the larva is noted 4-5 hours prior to eclosion. Segmentation of the larva is quite distinct at this stage. Later 4-5 hours after the start of the wriggling movement a rupture forms on the chorion at the cephalic end of the

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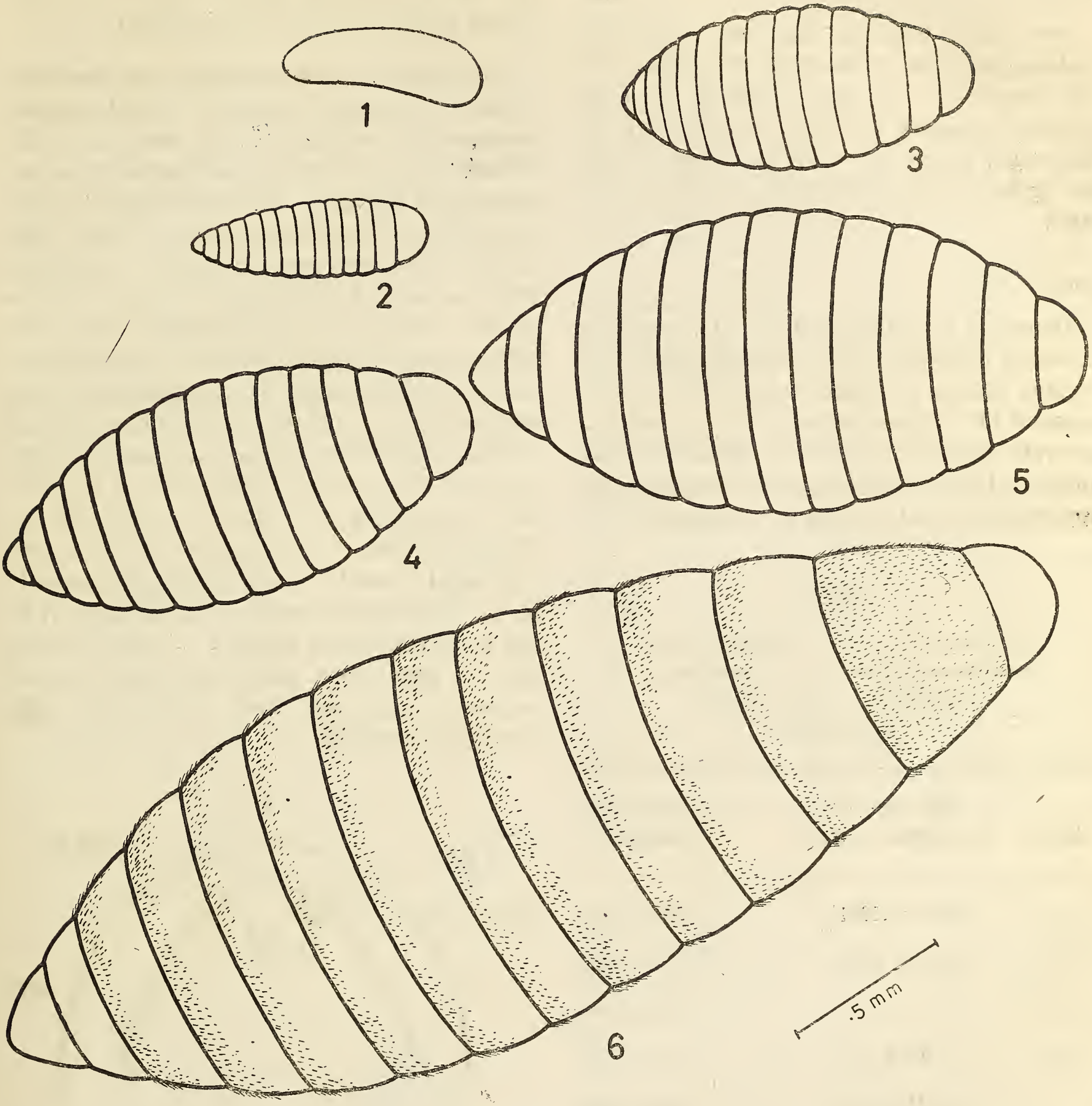


Fig. 1. Egg.

Figs. 2-6. Larval instars (first to fifth).

egg due to the action of the mandibles and possibly from the increased pressure from within the egg. Through this rupture, the larval head first protrudes out. The wriggling movement of the larva finally enables itself to escape completely from the chorion. It takes about 15-20 minutes for the larva to become completely free from the chorion.

Larva

Soon after hatching the first instar larva makes a puncture on the body of the host with the mandibles and starts feeding by continuously ingesting the host haemolymph by pharyngeal pumping. Once the parasite begins its regular feeding movements, development is rapid.

Larval instars

There are five larval instars. The measurements of mandibles and prothoracic spiracle of various instars are tabulated (Table 1). Because of the circular nature of the spiracles an accurate measurement can be taken from any angle, as long as the maximum diameter of the apparent elliptical out-line is considered.

TABLE 1

MEASUREMENT IN MM. OF THE SIZE OF THE PROTHORACIC SPIRACLE AND MANDIBLE OF DIFFERENT LARVAL INSTARS (MEAN ± SE)

Instar	Diameter of Prothoracic Spiracle	Length of Mandible
1	0.002 ± .0001	0.030 ± .002
2	0.009 ± .0003	0.035 ± .002
3	0.015 ± .002	0.047 ± .004
4	0.024 ± .003	0.057 ± .003
5	0.033 ± .002	0.068 ± .001

First instar larva (Fig. 2)

First instar larva is typically hymenopteriform with well defined head and thirteen body segments. It is glassy whitish in colour. The skin is smooth without any cuticular structures. The larva measures about 0.45-0.85 mm in length and 0.16 to 0.36 mm in width.

The head is thimble shaped and possesses a pair of stumpy antennae. Head capsule measures an average of 0.15 mm in width. Mouth opening is situated at the front end of the head at the apex. In describing the mouth parts (Fig. 7) the terminology of Vance and Smith (1933) has been employed. Epistoma, pleurostoma and hypostoma are clearly demarcated. Mandibles are triangular in outline and little chitinised. Each mandible is articulated anteriorly with the superior pleurostomal ramus and posteriorly with the inferior pleurostomal ramus. Mandibles consist of a main tooth followed by small bristle-like teeth in a comb-like arrangement along the inner edge (Fig. 8). Tracheal system is composed of two well developed lateral trunks united transversely in the first thoracic segment and posteriorly in the ninth abdominal segment. There are nine pairs of spiracles, a pair in the first thoracic segment and one each in the first eight abdominal segments.

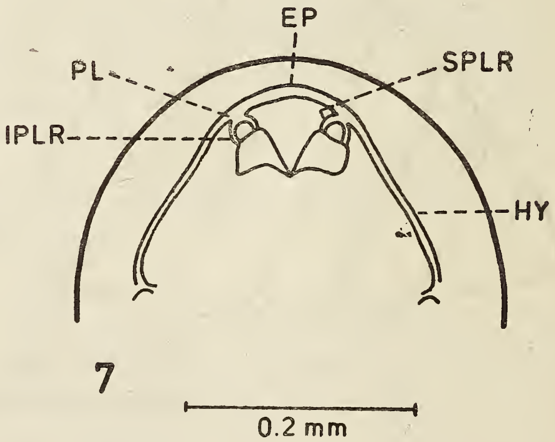


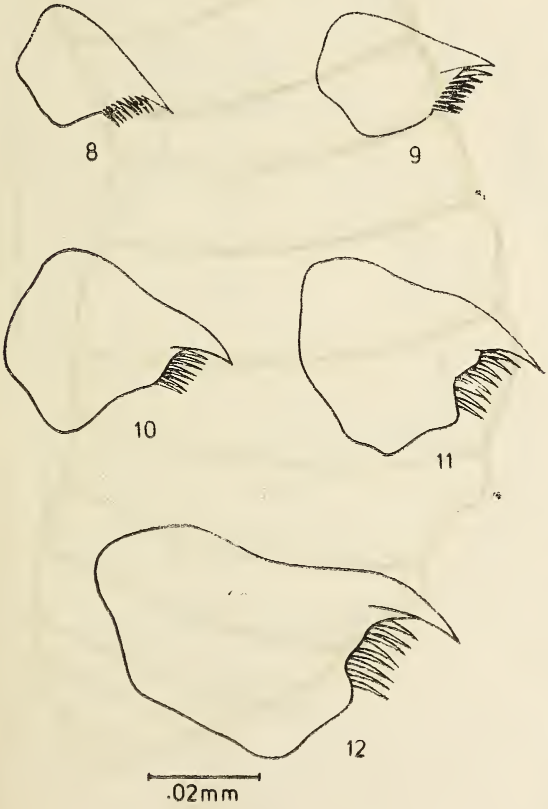
Fig. 7. Head of first instar larva—front view. EP—Epistoma, PL—Pleurostoma, SPLR—Superior pleurostomal ramus, IPLR—Inferior pleurostomal ramus, Hy-Hypostoma.

Second instar larva (Fig. 3)

Second instar larva measures 0.85-1.4 mm. in length and 0.36-0.50 mm. in width. The duration of second instar varies from 7 to 7.5 hours. It is translucent and pale yellowish white in colour. It can be readily distinguished from the previous stage by the sizes of the head capsule, mandibles (Fig. 9) and the spiracle. The head capsule measures an average of 1.9-2 mm. in width.

Third instar larva (Fig. 4)

The duration of third instar larva varies from 5 to 6.5 hours. It measures 1.2 to 1.9 mm in length and 0.52 to 0.72 mm. in width. Head capsule measures an average of 0.28 mm. in width. Mouth parts resemble that of second instar with increase in the size of the mandibles (Fig. 10).



Figs. 8-12. Mandibles of first to fifth instar larval stages.

Fourth instar larva (Fig. 5)

Fourth instar larva shows only minor differences from the third instar. Duration of the fourth instar varies from 6 to 6.5 hours. The larva measures 1.9 to 2.5 mm. in length and 0.72 to 0.85 mm. in width. Head capsule measures 0.35 mm. in width on the average. Mandibles show remarkable change in the shape (Fig. 11).

Fifth instar larva (Fig. 6)

Fifth instar stage is reached 26-29 hours after eclosion and its duration varies between 12 and 13 hours. The body is yellowish white in colour and it tapers towards both ends. It can be easily distinguished from the previous stage by the presence of cuticular spines in all segments, except in the ninth and tenth abdominal ones. The cuticular spines are arranged as transverse bands on each segment and is absent on the ventral side. Fifth instar larva measures about 2.27-3.18 mm in length and 0.85-1.2 mm in width.

The head (Fig. 13) shows distinct features. The various parts are : the vertex, the temporal region, the antennal region, frontal region and the genal region. The mouth parts are quite distinct. The mandibles (Fig. 12) are well sclerotised and brownish at the tip. Main tooth is followed by eight bristle-like teeth arranged in a comb-like fashion. Labrum is enclosed above by epistoma. Maxilla is bounded above by hypostoma and below by maxillary sclerome. Cardo and stipes are demarcated by a stout vertical thickening of chitin, the stipital sclerome. Middle region of the labium is thickened into an oral area bounded

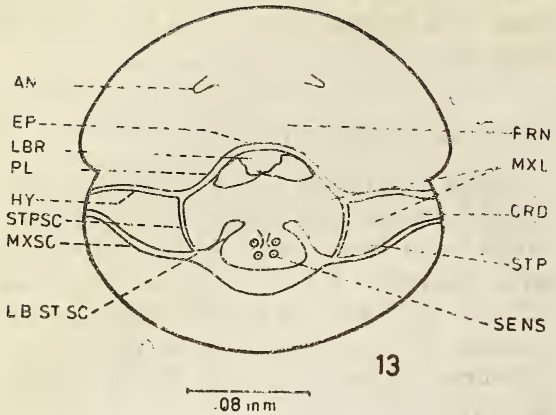


Fig. 13. Head of Final instar larva—front view.

AN—Antennal bud, MXL—Maxilla, EP—Epistoma, CRD—Cardo, FRN—Frontal region, STP—Stipes, SENS—Sensilla, LBR—Labrum, LBSTSC—Labiostipital sclerome, MXSC—Maxillary sclerome, STPSC—Stipital sclerome, HY—Hypostoma, PL—Pleurostoma.

by labiostipital sclerome. Labium preserves its division into postmentum and prementum. Tracheal system is well developed. The number of spiracles is same as in the first instar larva.

Prepupa and cocoon

The end of larval duration is when the larva stops feeding. Total duration of the larval stages of *B. brevicornis* varies from 39 to 43.5 hours. The full fed larva first detaches from the hosts' body and starts spinning a cocoon with white silken fibres. Usually, the larvae which detach from the same host body construct their cocoon very close to each other. The Cocoon is oval in outline with a convex dorsal surface and a flat base. Outer surface of cocoon is translucent whereas the base is transparent and the larva lying inside is visible. Cocoon measures about 3.63 mm. in length and 1.7 mm. in width on an average. Each larva usually takes about 8-10 hours to construct its cocoon. After construction of the cocoon, within 14-20 hours the larva voids its meconium which is stored at the posterior end of the cocoon as a black semi-solid mass. The larva at this stage is called as prepupa. Prepupa (Fig. 14) is yellowish white in colour. Cuticular spines present on the body as in the case of fifth instar larva.

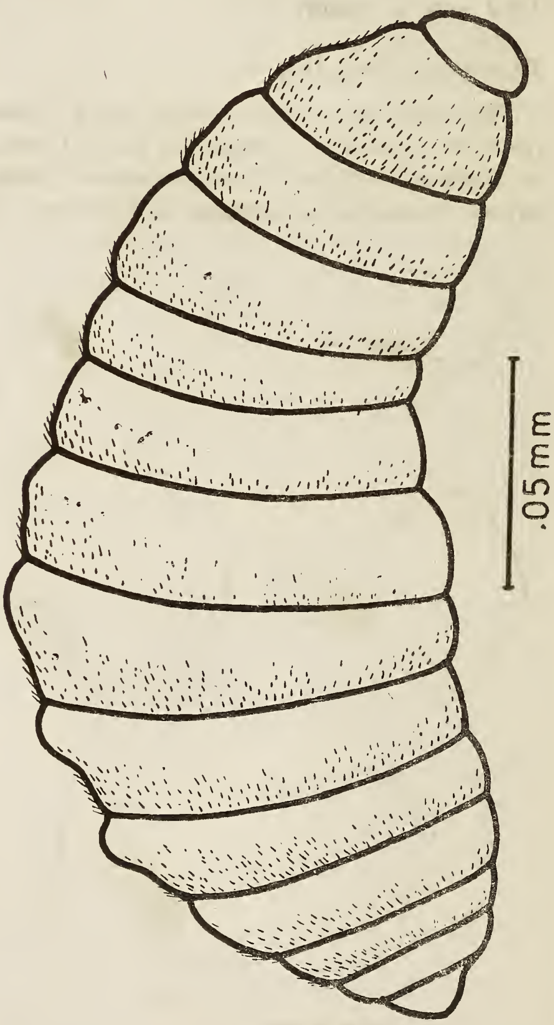


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Fig. 14. Prepupa—Lateral view.

It is sluggish and is capable of feeble wriggling action.

Pupa (Fig. 15)

Prepupal stage lasts about 13 to 15 hours. Prior to pupation thoracic and abdominal regions become differentiated by a construction at the junction of fourth and fifth segments. The prepupa finally casts off its skin and the pupa emerges. Pupa is exarate and yellowish white in colour. About 24 to 32 hours after pupation the body colour changes into pale reddish brown. The eyes and the three ocelli which are red in colour later change to black. The head of the pupa is flexed downwards. Antennae are directed backwards on the ventral surface. Developing wing pads are distinct. Segmentation of the abdomen is distinct. The duration of pupal stage varies between 72 to 84 hours.

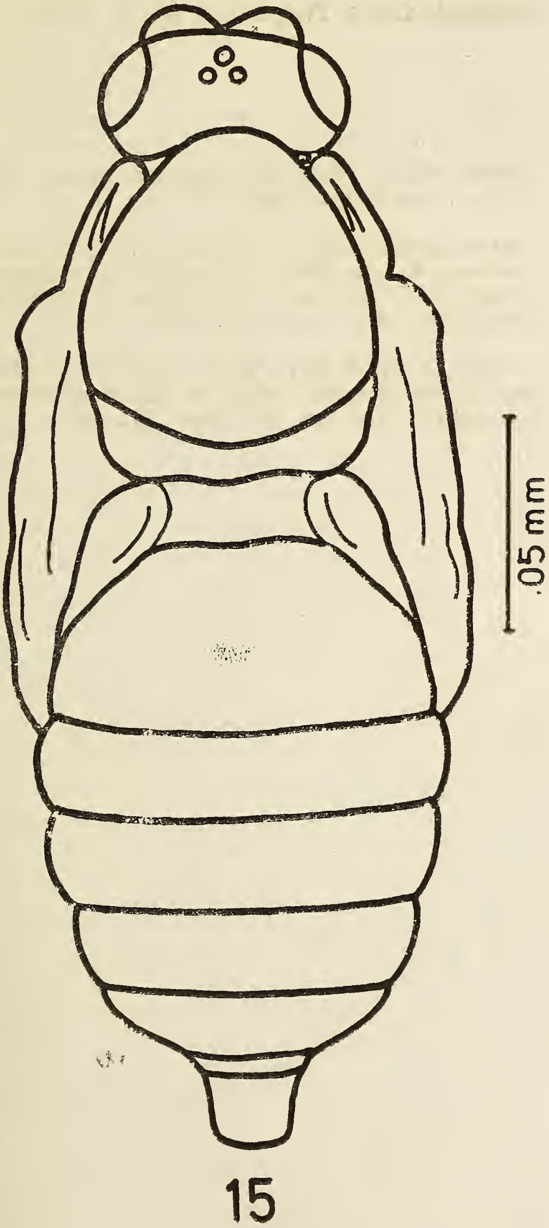

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Fig. 15. Pupa—dorsal view.

Emergence

Approximately ten hours before emergence, pupal moult takes place. At first, the pupa lies with its ventral side facing the base of the cocoon. After its primary emergence from the pupal exuvium, the adult turns round and lies upside down within the cocoon with its dorsal side facing the base of the cocoon. Prior to secondary emergence from the cocoon, the adult gnaws an irregular hole at the antero-dorsal side of the cocoon. Later it comes out through this hole.

Discussion

According to Clausen (1940) the eggs of *Microbracon lendicivorus* have a slender tapering stalk, slightly longer than the egg body. In *Bracon brevicornis* the egg is cylindrical, elongate and represents the general form of braconid egg. Munro (1917) observed that in *B. hylobii* Ratz. the early larval stages possessed no spiracles and they first appeared only in the fourth instar stage. *B. brevicornis* shows the presence of 9 pairs of spiracles throughout the larval stages. According to Clausen (1940) the mandibles of *B. tachardiae* are 4 dentate and it reveals an increasing number of small teeth on the inner margin of the mandibles, in the intermediate instars; the four teeth of the first instar are succeeded by five in the second and third. In the case of *B. brevicornis* the main tooth is followed by eight small teeth in comb-like arrangement, from the first instar stage onwards.

ACKNOWLEDGEMENT

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THE AQUATIC AND MARSHLAND FLORA OF KHERI DISTRICT, UTTAR PRADESH[1]

K. K. Singh[2] and R. P. S. Tomar[3]

(*With a text-figure*)

The paper presents an account of the aquatic and marshy angiosperms of Kheri district, Uttar Pradesh. Topographical and climatic conditions of the area have been described. The whole area of present investigation comprises six main forest ranges and distribution of species along with field numbers is recorded. The present study shows that 179 species of angiosperms belonging to 54 families inhabit the lakes, ponds, swamps, marshes and river banks of the district.

Introduction

In India the study on hydrophytes and marshland plants has been carried out by a number of workers : Biswas and Calder (1937), Misra (1946), Mirashi (1954, 1957, 1958), Sen and Chatterjee (1959), Subramanyam (1962), Maheshwari (1960) and Vyas (1964) etc. The systematic and ecological studies on aquatic and marshy plants of Kheri district has been undertaken while conducting floristic studies of the forest of the district. The area has been partly botanically explored by Duthie (1923), P. C. Kanjilal (1966) and G. Saran (1954 & 1956) of National Botanical Research Institute Lucknow. However, no separate work on aquatic plants of Kheri district has been published. A thorough study of the present day aquatic and marshland plants is, therefore, necessary. The area was surveyed in different seasons during the years 1972 to 1978. Specimens are preserved in the Medicinal Plant herbarium of Central Drug Research Institute, Lucknow. The order of families followed in this paper is according to Bentham and Hooker's Genera Plantarum 1862-63. However, in splitting of certain families, Hutchinson's (ed. 1959, 1973) classification has been adopted. An attempt has been made to bring the nomenclature up-to-date as far as possible.

Location and Habitats

Kheri district occupies north-west position in Uttar Pradesh between 27° 41′ and 28° 42′ N. latitude and 30° 2′ and 81° 19′ E. longitude. The district is bounded on east by the district of Baharaich, from which it is separated by river Kauriala, on the south by Sitapur and Hardoi, on the west by Shahjahanpur and Pilibhit districts and on the north by the territory of Nepal, separated by Mohan river. The thick forest belts are situated in the terai regions of the foothills of Himalayas in close vicinity of the territory of Nepal. It occupies a total area of 4,740 sq. km. Major parts of the district are provided with permanent ponds, Jheels, riverbeds and marshes which get filled up by water during the rainy season and maintain a rich aquatic and marshland flora. The present study conducted over a greater part of the district with special reference to the following ranges from where the species have been collected.

1. Mailani, 2. Golagokarannath, (3) Dudwa, (4) Bankati, (5) Bellrain, (6) Sonaripur. These ranges have a large number of ponds, ditches, jheels, river banks and marshes which support

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rich aquatic and marshy vegetation throughout the year. (Fig. 1).

TOPOGRAPHY AND SOILS

In its general aspect, Kheri district occupies large stretches of alluvial plain, covered in the northern half with forests and intersected in between by many rivers and water courses. In general, the slope of the district is from north-west to south-west. A major portion of the district is low-lying and gets filled with water during the rainy season. Marshlands occur commonly in the district. The district is mainly composed of gangetic alluvium showing a succession of beds of sands and loam, varying in depth according to the configuration of the ground. In areas where clay has been deposited on the surface as in depressions, the ground becomes swampy during the rainy season.

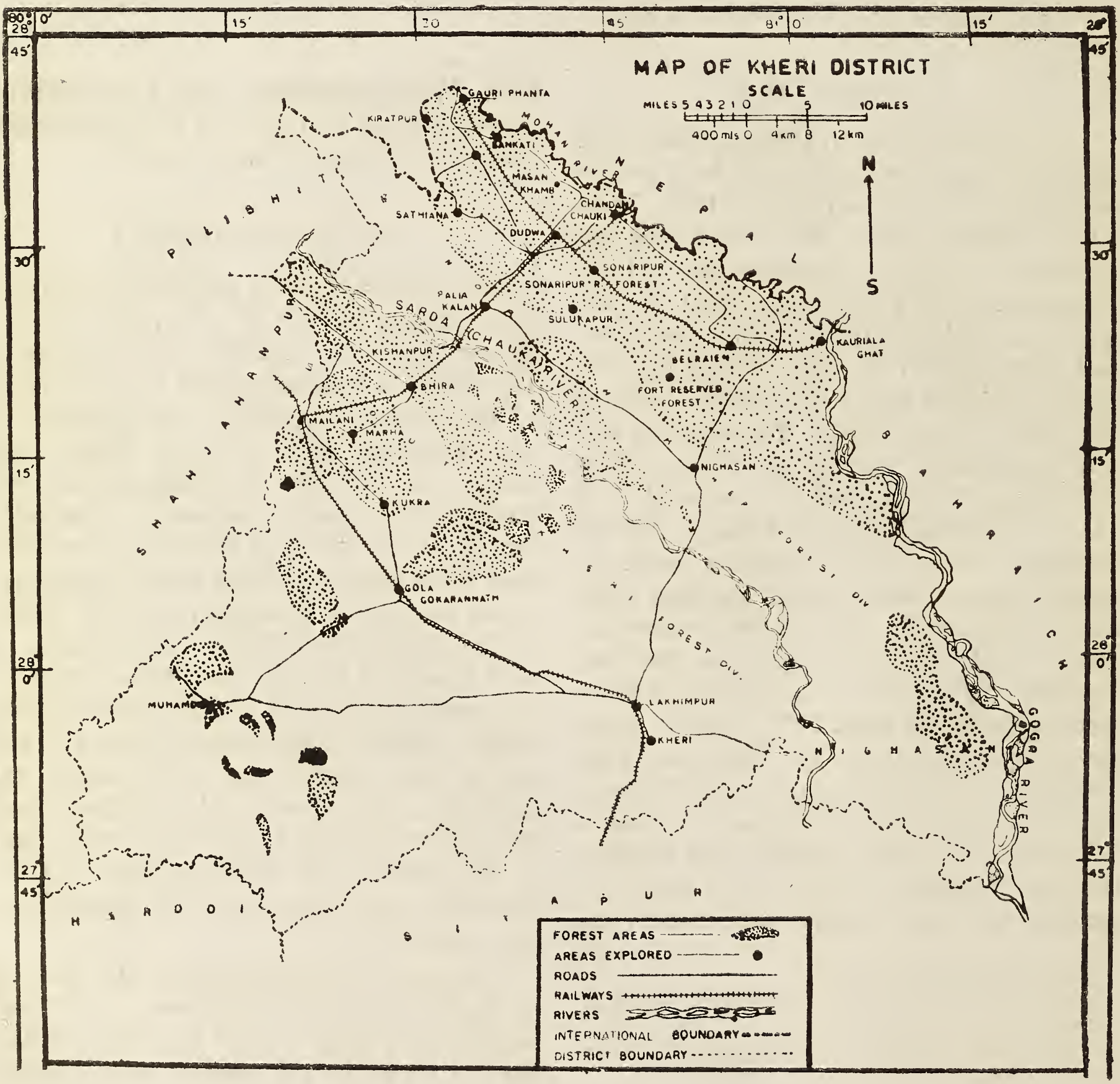
MAP OF KHERI DISTRICT
SCALE
MILES 5 4 3 2 1 0 5 10 MILES
400 mls 0 4 km 8 12 km
N
S
NEPAL
PILIBHIT
SHAHJAHANPUR
HARDOI
SITAPUR
BAHRAICH
GAURI PHANTA
KIRATPUR
MOHAN RIVER
BANKATI
MASAN KHAMB
CHANDAN CHAUKI
SATHIANA
DUDWA
SONARIPUR
SONARIPUR R. FOREST
PALIA KALAN
SARDA
CHAUKA RIVER
SULUKAPUR
KISHANPUR
BELRAIEN
KAURIALA GHAT
FORT RESERVED FOREST
BHIRA
MAILANI
MARHA
NIGHASAN
KUKRA
GOLA GOKARANNATH
FOREST DIV.
LAKHIMPUR
KHERI
MUHAMDI
NIGHASAN
GOGRA RIVER
FOREST AREAS
AREAS EXPLORED
ROADS
RAILWAYS
RIVERS
INTERNATIONAL BOUNDARY
DISTRICT BOUNDARY
80° 0'
15'
30
45'
81° 0'
28° 45'
30'
15'
28° 0'
27° 45'

Fig. 1. Map of Kheri District, Uttar Pradesh.

CLIMATE

The climate of Kheri district is of monsoon type. The year may be broadly divided into rainy, winter and summer seasons. The average total annual rainfall is about 1159.76 mm. The mean maximum temperature in May reaches as much as 46°C and mean minimum temperature is 8.32°C in the month of December.

OBSERVATIONS

The common habitats of hydrophytes and marshland vegetation are the lakes, ponds, bank of rivers, low-lying areas and marshy places of the district, which remain submerged throughout the year. The following six categories are recognised, depending upon the nature of habitats and their contact with soil, water and air :

1. Free-floating hydrophytes.
2. Suspended hydrophytes.
3. Submerged attached hydrophytes.
4. Floating attached hydrophytes.
5. Emergent, amphibious hydrophytes.
6. Wetland and marshy plants.

The aquatic and marshy vegetation shows some pure patches of plants like *Eichhornia crassipes* (Mart.) Solms, *Nelumbo nucifera* Gaertn., *Monochoria vaginalis* Presl, *Typha angustata* Bory & Chaub, *Potentilla supina* Linn., *Ranunculus sceleratus* Linn. in different localities of the district. Besides, there are number of common associations of aquatic and marshy species which are noticeable in these areas :

Associates of Aquatic plants :

(*a*) *Nymphaea, Eleocharis, Aeschynomene*
(*b*) *Potamogeton, Ottelia, Hygroryza.*
(*c*) *Nymphaea, Nymphoides, Hydrilla.*

Associates of Marshy and Wetland plants :

(*a*) *Ludwigia, Scirpus, Hydrolea.*
(*b*) *Caesulia, Tenagocharis, Sphenoclea.*
(*c*) *Phragmites, Oxystelma, Carex.*
(*d*) *Ipomoea, Hydrolea, Ammannia.*

Plants like *Eclipta prostrata* (Linn.) Linn., *Alternanthera sessilis* (Linn.) D.C. *Ipomoea aquatica* Forsk., *Ammannia baccifera* Linn. show wide range of distribution. The present study shows that one hundred and seventy-nine species of angiosperms belonging to fifty-four families inhabit the lakes, ponds, marshes and river beds of the district.

ENUMERATION OF THE TAXA

1. RANUNCULACEAE

1. Ranunculus sceleratus Linn.

Common in marshes of the district. Fl. March to June. Local name *Jaldhania.* KKS 2810, 7266.

2. R. cantoniensis DC.

Rare, Bankati range of the district in marshes. Fl. April to May. KKS 7164.

2. NYMPHAEACEAE

3. Nymphaea nouchali Burm. f.

Common in ponds and jheels during the rainy season. Fl. August to October. Local name: *Kumodini, Kokaveli.* KKS 7440.

4. Nymphaea stellata Willd.

Occasional in ponds and lakes, often mixed with *N. nouchali* Burm. f. Fl. August to October. Local name : *Chota Kamal.* KKS 7508, 7696.

3. NELUMBONACEAE

5. Nelumbo nucifera Gaertn.

Frequent in jheels and ponds. Fl. April to October. Local name : *Kamal.* KKS 3007,

4. BRASSICACEAE (CRUCIFERAE)

6. Rorippa indica (Linn.) Hiern

Occasional in moist shady places. Fl. February to August. KKS 2933, 4306.

7. Coronopus didymus (Linn.) Sm.

Frequent in moist places. Fl. January to April. KKS 7792.

5. ELATINACEAE

8. Bergia ammannioides Heyne ex Roth

Rare, in wet and marshy places along with *Ammannia* spp. Fl. November to May. KKS 7791.

6. STERCULIACEAE

9. Melochia corchorifolia Linn.

Common in muddy and marshy places. Fl. July to September. KKS 7443, 7732.

7. TILIACEAE

10. Corchorus aestuans Linn.

Common in moist shady places. Fl. August to October. KKS 3069, 7561.

11. C. capsularis Linn.

Frequent on moist ground. Fl. July to September. KKS 3064.

8. FABACEAE (PAPILIONACEAE)

12. Aeschynomene indica Linn.

Common in wastelands, ponds and rice fields. Fl. July to October. Local name : *Jhingini*. KKS 2968, 7711.

9. ROSACEAE

13. Potentilla indica (Andr.) Wolf.

Occasional in moist shady places and in marshy area. Fl. September to October. KKS 7342, 8365.

14. P. supina Linn.

Common throughout the area in marshy and muddy areas. Fl. January to April. KKS 2887, 7103, 8402.

10. MYRTACEAE

15. Syzygium heyneanum (Duthie) Wall. ex-Gamble

Occasional on river banks and in swamps. Fl. April to September. Local name : *Kathjamuni*. KKS 7352.

11. LECYTHIDACEAE

16. Barringtonia acutangula (Linn.) Gaertn.

Found frequently in marshy places and along river banks. Fl. May to September. Local name : *Panyala*. KKS 4342.

12. LYTHRACEAE

17. Ammannia baccifera Linn.

Common in moist and marshy places throughout the area. Fl. major part of the year. KKS 4149, 7219.

18. A. multiflora Roxb.

Common in moist and marshy places. Fl. October to January. KKS 4148.

19. Rotala indica (Willd.) Koehne

Common in moist and muddy places along forest roads. Fl. October to January. KKS 4180, 7859.

20. R. mexicana Cham. & Schlect.

Common on moist and muddy ground along forest roads. Fl. October to December. KKS 4203, 7857.

13. ONAGRACEAE

21. Ludwigia adscendens (Linn.) Hara

Common in ponds during rainy season. Fl. September to November. KKS 3083, 4368, 7409.

22. L. prostrata Roxb.

Frequent in moist and muddy places along forest roads. Fl. August to November. KKS 7538, 7713, 8482.

23. L. octovalvis (Jacq.) Raven subsp. **sessiliflora** (Mich.) Raven

Frequent in marshy and water-logged areas. Fl. October to December. KKS 4261, 7887.

24. L. perennis Linn.

Common in muddy and shaded areas along forest roads. Fl. September to November. KKS 7413, 7538, 8532.

14. TRAPACEAE

25. Trapa natans Linn. var. **bispinosa** (Roxb.) Makino

Commonly cultivated in ponds and jheels in the area. Fl. August to November. Local name : *Singhara*. KKS 7694.

15. MOLLUGINACEAE

26. Glinus lotoides Linn.

Common in drying ponds, puddles and moist sandy places. Fl April to August. KKS 2927.

16. APIACEAE (UMBELLIFERAE)

27. Hydrocotyle sibthorpoides Lamk.

Rare in moist and muddy places. Fl. September to November. KKS 7651.

28. Centella asiatica (Linn.) Urban

Common in moist, shady places and along river banks. Fl. April to August Local name : *Brahmi*. KKS 2931, 4223, 7137.

29. Cnidium monnieri (Linn.) Cusson

Frequent in open, muddy and marshy places. Fl. April to May. KKS 2938, 7162.

17. RUBIACEAE

30. Cephalanthus occidentalis Linn.

Occasional in marshy area along river bank. Fl. March to July. Inayat 22381.

31. Oldenlandia corymbosa Linn.

Frequent in moist and muddy places. Fl. September to October. KKS 4168, 4209.

32. O. paniculata Linn.

Occasional in moist and marshy places. Fl. August to October. KKS 3039, 7955.

33. Hyptianthera stricta W. & A.

Rare in marshy places. Fl. March to May. KKS 7140, 7195.

34. Borreria articularis (Linn. f.) F.N. Wils.

Common in marshy places. Fl. August to October. KKS 3012, 7434.

18. ASTERACEAE (COMPOSITAE)

35. Adenostemma lavenia (Linn.) O. Ktze. var. **lavenia**.

Common in moist, shady and marshy places. Fl. September to February. KKS 4171, 7938.

36. Caesulia axillaris Roxb.

Frequent in marshy places and in rice fields. Fl. September to April. KKS 4255, 4325, 7803.

37. **Dichrocephala integrifolia** (Linn. f.) O. Ktze.

Occasional in moist, shady, and marshy places. Fl. August to October. KKS 4133, 7327.

38. **Centipeda minima** (Linn.) A. Br. & Aschers.

Frequent in moist and muddy places. Fl. October to December. Local name: *Nakchikani*. KKS 2895, 7156.

39. **Cotula anthemoides** Linn.

Occasional in moist and marshy places. Fl. February to March. KKS 4340, 7178.

40. **C. hemisphaerica** (Roxb.) Wall. ex Clarke

Occasional in marshy places. Fl. January to March. KKS 7683.

41. **Cyathocline purpurea** (D. Don) O. Ktze.

Common in marshy places and along river banks. Fl. November to March. KKS 7186, 7227.

42. **Emilia sonchifolia** (Linn.) DC.

Frequent in muddy places and other moist places. Fl. September to November. KKS 7633, 7715.

43. **Eclipta prostrata** (Linn.) Linn.

Common in marshy places. Fl. most part of the year. Local name: *Bhangara*. KKS 7168.

44. **Grangea maderaspatana** (Linn.) Poir.

Common in marshy places and along river banks, puddles etc. Fl. October to March. KKS 2884, 7182, 7589, 8328.

19. CAMPANULACEAE

45. **Lobelia alsinoides** Lamk.

Common in moist and muddy grounds along forest roads. Fl. September to December. KKS 4184, 8511.

46. **Wahlenbergia marginata** (Thunb.) DC.

Frequent in damp places and along river streams. Fl. November to March. KKS 7110, 7128, 7638.

47. **Campanula benthamii** Wall. ex Kitamura

Frequent in moist, shady places and along river banks. Fl. December to March. KKS 2854, 7102, 7105.

20. SPHENOCLEACEAE

48. **Sphenoclea zeylanica** Linn.

Frequent in marshy areas and in rice fields. Fl. August to November. KKS 7482, 8488.

21. PRIMULACEAE

49. **Primula umbellata** (Lour.) Bentv.

Occasional in moist, shady places. Fl. December to March. KKS 7104, 7636.

50. **Lysimachia candida** Lindl. subsp. **abovata** R. Kunth

Rare in marshy places. Fl. March to October. KKS 7952.

22. ASCLEPIADACEAE

51. **Oxystelma secamone** (Linn.) K. Schum.

In marshy places and along river banks. Fl. July to November. Local name: *Dudhibel*. KKS 4356, 7492.

23. GENTIANACEAE

52. **Nymphoides indicum** (Linn.) O. Ktze.

Commonly in ponds, Jheels etc. Fl. April to October. KKS 7697, 8340.

53. **Canscora decussata** (Roxb.) Roem & Schult.

Frequent in moist and marshy places. Fl. August to November. KKS 4207, 7850.

24. HYDROPHYLLACEAE

54. Hydrolea zeylanica (Linn.) Vahl.

Common in marshy places and in rice fields. Fl. September to December. KKS 4270, 7846.

25. CONVOLVULACEAE

55. Volvulopsis nummularia (Linn.) Roberty

Frequent in muddy places. Fl. August to February. KKS 3052.

56. Ipomoea aquatica Forsk.

Common in muddy places near pond. Fl. September to February. KKS 2890, 3082, 4109.

26. SCROPHULARIACEAE

57. Verbascum chinense (Linn.) Sant.

Occasional along river banks. Fl. February to April. KKS 8409.

58. Striga angustifolia (D. Don) Saldanha.

Occurs near the banks of ponds amongst grasses. Fl. September to November. KKS 7476, 7700.

59. Lindenbergia macrostachya (Benth.) Benth.

Rare. Along river banks. Fl. February to May. KKS 7101, 7118, 8393.

60. Mazus pumilus (Burm. f.) van Steenis

Frequent along river banks. Fl. September to February. KKS 4251.

61. M. delavayi Bonati.

Occasionally in moist places and along river banks. Fl. September to December. KKS 7116, 7637.

62. Limnophila indica (Linn.) Druce.

Common in permanent pools, ponds and in marshy places. Fl. September to December. KKS 4275, 4328, 7856, 7870.

63. Lindernia crustacea (Linn.) F. Muell.

Occasionally in marshy places. Fl. September to December. KKS 7463, 8464.

64. L. ciliata (Colsm.) Pennell.

Frequent in moist and marshy places. Fl. September to December. KKS 7428.

65. L. anagallis (Burm f.) Pennell.

Frequent in moist shady and marshy places. Fl. September to December. KKS 3038, 4146.

66. Bacopa monnieri (Linn.) Pennell.

Occasionally in wet and marshy places. Fl. August to November. KKS 3071, 7941.

67. Mella hamiltoniana (Benth.) Pennell.

Rare in marshy places. Fl. September to October. KKS 8502.

68. Veronica anagallis-acquatica Linn.

Common in marshy places and along river banks. Fl. February to April. KKS 7107, 7232, 8324.

27. LENTIBULARIACEAE

69. Utricularia aurea Lour.

Frequent in stagnant water of ponds and ditches etc. Fl. September to December. KKS 7568.

28. ACANTHACEAE

70. Hygrophila auriculata (K. Schum.) Heine.

Common in marshy places and near ponds and ditches. Fl. October to December. KKS 2892.

71. H. salicifolia (Vahl) Nees.

Occasional in moist and marshy places. KKS 7580.

72. **Hemiadelphus polyspermus** (Roxb). Nees.

Common in marshy places and along river beds. Fl. September to March. KKS 2845, 2895, 7681, 7812, 8329.

29. VERBENACEAE

73. **Phyla nodiflora** (Linn.) Greene

Common in marshy places and along river banks. Fl. April to August. KKS 3075, 4115, 7224.

30. LAMIACEAE (LABIATAE)

74. **Acrocephalus indicus** (Burm. f.) O. Ktze.

Common in moist and marshy places. Fl. September to December. KKS 4165, 7851.

75. **Salvia plebeia** R. Br.

Common in moist places, along river banks and in marshes. Fl. September to April. KKS 2804, 2842, 4138, 7158, 8383.

76. **Eusteralis stellata** (Lour.) Panigrahi.

Frequent in marshy and muddy areas along forest roads. Fl. September to November. KKS 4280, 7809, DP Raturi 2557.

31. AMARANTHACEAE

77. **Centrostachys aquatica** (R. Br.) Wall. ex-Moq.

Rare in ponds. Fl. September to December. KKS 7515.

78. **Alternanthera sessilis** (Linn.) DC.

Common in moist, marshy places and along river banks. Fl. Major part of the year. KKS 3066, 7155.

79. A. **paronychioides** St. Hil.

Common in marshy places and near ponds. Fl. All season. KKS 7259, 7466, 7604.

32. CHENOPODIACEAE

80. **Chenopodium ambrosioides** Linn.

Frequent along river banks. Fl. March to September. KKS 3048, 7329.

33. POLYGONACEAE

81. **Polygonum plebeium** R. Br.

Common in marshy places and near ponds etc. Fl. August to April. KKS 2809, 2814, 7169, 7319.

82. P. **glabrum** Willd.

Frequent in marshy places and along river banks. Fl. September to March. KKS 7828.

83. P. **lanigerum** R. Br.

Common in marshy places. Fl. September to December. KKS 7505, 7884.

84. P. **limbatum** Meissn.

Occasional in marshy places and near ponds. Fl. September to December. KKS 7661, 7976.

85. P. **barbatum** Linn. subsp. **gracile** Dansen.

Common in marshy places and in ditches. Fl. September to March. KKS 2978, 4226, 4303, 7223.

86. P. **hydropiper** Linn. subsp. **microcarpum** Danser var. **lenticularis** Danser.

Occasional in marshy places and in ditches. Fl. September to March. KKS 7559, 8920, 8404, 8471.

87. **Rumex dentatus** Linn.

Common in marshy places and along river beds. Fl. January to June. KKS 2828, 7138, 7593, 8325.

34. PIPERACEAE

88. Piper longum Linn.

Common in moist and marshy places in sal forest. Fl. August to October. Local name: *Piper*. KKS 3042, 7963, 8478.

35. EUPHORBIACEAE

89. Bischofia javanica Blume.

Rare in moist and marshy places. Fl. March to April. KKS 7911.

90. Trewia nudiflora Linn.

Frequent in marshy places. Fl. February to April. Local name: *Gutel*. KKS 2905, 7188, 7655.

91. Glochidion lanceolarium Voigt

Frequent in marshy places. Fl. March to April. KKS 3059, 7964.

92. G. multiloculare Voigt.

Occasional in marshy places. Fl. March to May. KKS 4304, 8497.

93. Kirganelia reticulata (Poir.) Baill.

Frequent in marshy places and along streams. Fl. April to July. KKS 2848, 7130, 7625.

36. URTICACEAE

94. Pouzolzia zeylanica (Linn.) Benn.

Frequent along river banks and in moist shady places. Fl. September to January. KKS 2989, 3043, 4170.

95. P. pentandra (Roxb.) Benn.

Occasional in moist places along streams. Fl. September to January. KKS 7885.

96. P. hirta (Bl.) Hassk.

Rare. Along streams and in moist places. Fl. September to December. KKS 7965.

37. MORACEAE

97. Ficus heterophylla Linn. f.

Frequent in marshy places. Fl. October to May. KKS 7258, 7328, 7667, 7954.

38. SALICACEAE

98. Salix tetrasperma Roxb.

Frequent along river beds. Fl. October to March. Local name: *Sukulbent*. KKS 2880, 4217, 7986.

39. CERATOPHYLLACEAE

99. Ceratophyllum demersum Linn.

Common in lakes, ponds and ditches. Fl. September to November. KKS 2559.

40. HYDROCHARITACEAE

100. Hydrilla verticillata (Linn. f.) Royle.

Frequent in tanks and ponds and slowly running water of ditches. Fl. September to November. KKS 8354, 8419.

101. Ottelia alismoides (Linn.) Pers.

Common in tanks, ponds and slow running water. Fl. September to December. KKS 7556, 7708.

102. Vallisneria spiralis Linn.

Frequent at the bottom of ponds and ditches. Fl. October to March. KKS 8564.

41. PONTEDERIACEAE

103. Eichhornia crassipes (Mart.) Solms.

Common in ponds and ditches forming pure patches. Fl. September to November. Local name: *Jalkumbhi*. KKS 7370.

104. Monochoria vaginalis (Burm. f.) Presl.

Common in marshy places and along the edge of ponds. Fl. August to November. KKS 7483, 7748, 3489.

42. COMMELINACEAE

105. Amischophacelus axillaris (Linn.) R. Rao & Kammathy.

Common in marshy places. Fl. August to December. KKS 4272, 7541.

106. Cyanotis cristata (Linn.) D. Don

Frequent in damp and muddy places. Fl. July to November. KKS 4216, 7539, 7819.

107. Murdannia scapiflora Roxb.

Occasional in marshy places. Fl. August to November. KKS 4139.

43. JUNCACEAE

108. Juncus prismatocarpus R. Br.

Occasional in marshy places. Fl. October to April. Inayat 22831.

109. J. bufonius Linn.

Frequent in moist and marshy places. Fl. October to March. G. Saran 26298, 26374.

44. ARECACEAE (PALMAE)

110. Calamus tenuis Roxb.

Frequent in marshy areas and along river banks. Fl. September to December. Local name : *Bent.* KKS 7713.

45. TYPHACEAE

111. Typha augustata Bory & Chaub.

Common in marshy places. Fl. May to November. Local name : *Pater.* KKS 7652, 7940.

46. ARACEAE

112. Pistia stratiotes Linn.

Rare. In still water of tanks and ditches. Fl. August to November. KKS 7830.

113. Plesmonium margaritiferum Schott

Rare. In marshy places. Fl. August to October. KKS 7745.

47. LEMNACEAE

114. Lemna paucicostata Hegelm.

Frequent in ponds and ditches. KKS 8410.

115. Wolfia arrhiza (Linn.) Horkel ex-Wimmer

Occasional in ponds and ditches. KKS 8412.

116. Spirodela polyrhiza (Linn.) Schleid

Common in still water of ponds and ditches. KKS 8411.

48. ALISMATACEAE

117. Sagittaria sagittifolia Linn.

Frequent in marshy places. Fl. September to February. KKS 7353.

118. S. guayanensis H. B. & K.

Occasional in marshy places and in ponds. Fl. September to December. KKS 7484, 7695.

119. Caldesia parnassifolia (Linn.) Parl.

Rare. In stagnant water of ponds. Fl. July to October. KKS 7555.

49. BUTOMACEAE

120. Tenagocharis latifolia (D. Don) Buchen.

Occasional in open marshy places and in rice fields. Fl. September to December. KKS 4334, 7847.

50. APONOGETONACEAE

121. Aponogeton crispum Thunb.

Frequent in ponds and jheels. Fl. August to November. KKS 7553.

51. POTAMOGETONACEAE

122. Potamogeton nodosus Poir.

Occasional in ponds and in marshy places. Fl. November to December. KKS 7268.

123. P. crispus Linn.

Frequent in ponds. Fl. December to April. KKS 7245.

124. P. pectinatus Linn.

Common in ponds and tanks. Fl. October to April. KKS 7246, 8460.

52. ERIOCAULACEAE

125. Eriocaulon cinereum R. Br.

Common in marshy places and in rice fields. Fl. September to January. KKS 7489, 7854.

53. CYPERACEAE

126. Carex cernua Boott.

Occasional in marshy places. Fl. February to April. Inayat 22886.

127. C. fedia Nees.

Common in marshy places and near ponds etc. Fl. September to April. KKS 2819, 7172, 7660.

128. Cyperus michelianus (Linn.) Link subsp. **pygmaeus** (Rottb.) Asch. & Graebn.

Frequent near ponds and marshy places. Fl. October to July. Inayat 23898.

129. C. triceps (Rottb.) Endl.

Occasional in moist and marshy places. Fl. September to October. KKS 8568.

130. C. kyllingia Endl.

Common in marshy places. Fl. August to March. KKS 2955, 4181, 7418.

131. C. cyperoides (Linn.) O. Ktze.

Common in marshy places. Fl. September to November. KKS 3017, 7916, 8470, 8522.

132. C. compactus Retz.

Frequent in moist and marshy places. Fl. August to November. KKS 2953, 4271, 7451.

133. C. platystylis R. Br.

Occasional in marshy places and along river banks. Fl. July to February. Sis Ram 46453.

134. C. difformis Linn.

Occasional in marshy places. Fl. August to December. KKS 8425.

135. C. silltensis Nees.

Frequent in marshy places. Fl. August to November. KKS 4362, 7893, 8510.

136. C. tenuispica Steud.

Occasional in rice fields and other marshy places. Fl. October to November. KKS 7491.

137. C. haspan Linn.

Occasional in marshy places. Fl. September to November. KKS 7889.

138. C. compressus Linn.

Frequent in moist and marshy places. Fl. August to November. KKS 8432.

139. C. iria Linn.

Common in rice fields and other marshy places. Fl. August to November. KKS 2976, 7472, 8446.

140. **C. alulatus** Kern.

Common in rice fields and in other marshy places. Fl. September to November. KKS 2977.

141. **C. niveus** Retz.

Frequent in moist and marshy places. Fl. July to October. KKS 7387.

142. **C. corymbosus** Rottb.

Frequent in marshy places. Fl. August to November. KKS 8505.

143. **C. digitatus** Roxb.

Frequent in moist shady and marshy places. Fl. August to December. KKS 8472.

144. **C. pilosus** Vahl.

Occasional in marshy places and in rice fields. Fl. August to December. KKS 7557, 7763.

145. **C. distans** Linn. f.

Frequent in moist and muddy places. Fl. August to October. KKS 8459, 8526.

146. **C. pangorei** Rottb.

Frequent in moist and muddy places. Fl. August to January. KKS 8437.

147. **C. exaltatus** Retz.

Common in marshy places. Fl. August to December. KKS 2951, 7452, 7755.

148. **Eleocharis dulcis** (Burm. f.) Henschel.

Frequent in marshy places and in shallow water of ponds and ditches. Fl. September to December. KKS 8426.

149. **E. atropurpurea** (Retz.) Kunth.

Common in marshy places and in rice fields. Fl. September to December. KKS 7488.

150. **E. palustris** R. Br.

Common in marshy places. Fl. October to April. KKS 7664, 8428.

151. **Fimbristylis bisumbellata** (Forsk.) Bub.

Common along river banks and other marshy places. Fl. February to April. KKS 7174, 7241, 7709, 8469.

152. **F. dichotoma** (Linn.) Vahl.

Frequent in muddy places and in rice fields. Fl. July to November. KKS 3045, 4159, 7552.

153. **F. littoralis** Gand.

Common in rice fields and other marshy places. Fl. September to December. KKS 8455.

154. **Scirpus affinis** Roth.

Frequent in marshy places. Fl. February to May. KKS 7323, 8329.

155. **S. michelianus** Linn.

Occasional in marshy places. Fl. September to November. Inayat 22864.

156. **S. articulatus** Linn.

Frequent in marshy and muddy places. Fl. September to November. KKS 4295, 7351.

157. **S. mucronatus** Linn.

Occasional in muddy places. Fl. September to November. KKS 8338.

158. **S. tuberosus** Desf.

Occasional in marshy places. Fl. September to December. Inayat 22872, 22866 (DD).

54. POACEAE (GRAMINEAE)

159. **Saccharum spontaneum** Linn.

Frequent in marshy places and along river banks. Fl. September to January. KKS 3028, 7500.

160. Ischaemum rugosum Salisb.

Common near ponds and marshy places. Fl. September to December. KKS 7945, 8423.

161. Hemarthira compressa (Linn. f.) R. Br.

Common in marshy places and in rice fields. Fl. July to September. KKS 8440, 8467.

162. Rottboellia exaltata Linn. f.

Frequent near ponds and along streams. Fl. August to November. KKS 7951.

163. Mnesithea laevis (Retz.) Kunth.

Frequent in marshy places and in rice fields. Fl. July to December. KKS 7707.

164. Vetiveria zizanioides (Linn.) Nash.

Common in marshy places. Fl. July to November. Local name : *Seenk.* KKS 2983, 7505, 7550, 7764.

165. Bothriochloa pertusa (Linn.) A. Camus

Frequent in marshy places. Fl. September to January. KKS 8540, 8551.

166. Panicum austroasiaticum Ohwi.

Frequent near ponds and other moist places. Fl. September to December. KKS 8524.

167. P. trypheron Schult.

Frequent in moist and muddy places. Fl. August to December. KKS 7722.

168. P. paludosum Roxb.

Common in marsh lands, still water, and banks of ponds. Fl. September to December. KKS 7730, 8473, 8563.

169. Hymenachne pseudointerrupta C. Muell.

Occasional in marshy places and in water-logged areas. Fl. September to December. KKS 7874.

170. Echinochloa stagnina (Retz.) P. Beauv.

Common in stagnant ditches and banks of ponds. Fl. August to December. KKS 7824, 8501.

171. E. colonum (Linn.) Link.

Common in rice fields and other marshy places. Fl. July to November. KKS 7523, 8417.

172. E. crusgalli (Linn.) Beauv.

Common in moist places, ponds and in rice fields. Fl. August to November. KKS 7761.

173. Paspalidium flavidum (Retz.) A. Camus

Common in marshy places and in rice fields. Fl. July to November. KKS 7886, 8424, 8442, 8505.

174. Paspalum distichum Linn.

Common in marshy places and in still waters of ponds, ditches etc. Fl. July to September. KKS 7417, 8427.

175. P. commersonii Lamk.

A weed in rice fields. Fl. September to January. KKS 2988.

176. Brachiaria reptans (Linn.) Gard. & Hubb.

Frequent in marshy places and in rice fields. Fl. September to January. KKS 8459.

177. Phragmites maxima (Forsk.) Blatt. & McC.

Common in marshy places and along streams beds. Fl. December to January. KKS 2818, 2997, 4229, 7240, 7498.

178. Hygroryza aristata (Retz.) Nees ex-W. & A.

Common in ponds, ditches etc. Fl. October to February. KKS 7454.

179. Oryza rufipogon Griff.

Common in rice fields and other marshy places. Fl. October to November. KKS 7746, 8487.

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RESTOCKING MUGGER CROCODILE *CROCODYLUS PALUSTRIS* (LESSON) IN ANDHRA PRADESH : EVALUATION OF A PILOT RELEASE[1]

B. C. CHOUDHURY[2] AND H. R. BUSTARD[3]

(*With two plates and three text-figures*)

Four years' monitoring results of a pilot mugger crocodile release carried out at Ethipothalla falls in Andhra Pradesh indicated excellent survival and growth and very little movement in the wild. The methodology of planning and carrying out a crocodile restocking programme together with the monitoring methods evolved during a four years' observation period are reported. The success of this pilot release programme provided the background for further large-scale releases in the State of Andhra Pradesh. First ever breeding of these released mugger took place in 1981.

INTRODUCTION

The Indian mugger (*Crocodylus palustris*) was considered to be a depleted species by Gee (1964), Misra (1970), Daniel (1970), Biswas (1970), Mukherjee (1974), Bustard (1974) and Shahi (1977). Naturally, the degree of depletion shows considerable regional variation in a country of the size of India. The Government of India Crocodile Project, following the advice of Bustard (FAO 1974), aimed to quickly rehabilitate India's three species of crocodilians by active management—collection of wild laid eggs for safe hatchery incubation and subsequent rearing of the young to a size of 1.20 m before restocking them in selected, well-protected areas of the natural habitat.

In 1976, the Andhra Pradesh Forest Department initiated a State Crocodile Project in association with the Government of India Project Crocodile Breeding and Management, receiving technical assistance from FAO/UNDP.

Detailed surveys carried out in the two major river systems of Andhra Pradesh (the Krishna and Godavari) and in the State's numerous reservoirs, during the winter of 1976/1977 indicated that the total population of mugger crocodiles in Andhra Pradesh was extremely small. Only six breeding females were recorded in the entire State and the total population estimate was 30 individuals of above 1.0-1.5m (Choudhury, in prepn.).

Clearly, the mugger was critically endangered in Andhra Pradesh. It was, therefore, considered essential to restock mugger in suitable habitat areas in the State which could be given adequate protection by gazetting them as sanctuaries, in order to build up natural breeding groups. This restocking would be carried out using project hatched and reared juveniles.

Bustard (FAO 1974), after examining several mugger habitats in Andhra Pradesh, had recommended the large pool and associated portion of the Chandravanka River, a tributary of the Krishna river immediately below the Ethipothalla waterfalls (Fig. 1), as an ideal area for pilot restocking purposes. Ethipothalla falls now lies in the easternmost limits of the Nagarjunasagar-Srisailam (Krishna) Sanctuary declared and gazetted through the Crocodile Project in June 1978. The sanctuary covers an area of 3600 sq. km. including much excellent mugger and tiger habitat. Bustard

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[1] Accepted December 1981.

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pointed out that Ethipothalla was a natural mugger habitat and recommended restocking using captive-reared juveniles from Nehru Zoological Park, Hyderabad, where a number of individuals of Andhra Pradesh stock were currently being reared. He also recommended a number of management objectives for the area. These included posting of guards to prevent people from going down to the falls, [both the falls and the crocodiles could be viewed from the top of the falls (FAO 1974)], and to prevent cattle grazing and cutting of grass and other disturbances in the river-bed below the falls. These proposals were accepted by the Government of Andhra Pradesh and the first release in Andhra Pradesh, which was also the first release of captive-reared mugger in Asia, took place at Ethipothalla falls on 8th February, 1977 at which time the guards were posted.

Subsequent releases, each of two individuals, took place on 23-12-78 and 16-9-1980 respectively.

In order to evaluate the success of this pilot release, on which further releases in the State would be based, detailed monitoring of the released mugger was devised in order to collect data on their survival, growth and movement in the wild. This paper sets out this methodology and presents results obtained over the last four years.[4]

RESTOCKING

The pilot restocking of mugger crocodiles in Andhra Pradesh required the following action to be taken :

1. Selection of :
   - (a) a release site
   - (b) the best time for release
   - (c) crocodiles to be released.
2. Pre-release check on the habitat to decide immediate action required.
3. Marking crocodiles for release.
4. Transporting crocodiles to the release site.
5. Actual release.

1 (a). *Selection of the release site*

Ethipothalla was chosen as the first release site on the basis of the recommendation made by Bustard (FAO 1974) specifically :

(a) The area was formerly a mugger habitat holding a good mugger population until the early 1960's.

(b) By 1977, the site was still ideal as a mugger habitat—in addition to the main pool immediately below the falls, there are ten other pools up to 5 m deep in a 3 km stretch of the Chandravanka river before joining the Krishna river 5 km below Ethipothalla falls. (Plate 1). These deep pools provide abundant perennial water. There is a good fish population in the pools. This fish population in the pools and small mammals from the surrounding jungle, provide food for the crocodiles.

The cessation of fishing activity under the management regime would ensure that the food resources would be available only for the crocodiles.

Additional advantages of this site for a pilot release of its kind were :

(a) a manageable small area for protection, from below the falls to the Krishna river confluence—a distance of 5 km. The ideal mugger habitat extended over approximately 3 km and, therefore, was easier to monitor closely.

(b) Since there were no existing mugger at the time of release all observed mugger could be positively identified as released individuals without the need to check for marking.

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[4] Following this, a further 176 mugger have been released into three wild life sanctuaries in Andhra Pradesh.

(c) The waterfall and crocodiles can be viewed easily from the top of the falls by research/wildlife staff and by visitors alike, with minimum disturbance.

1 (b). *Release time*

The chosen release site experiences the south-west monsoon from June to September. During this time the waterfall is usually in flood inundating the banks. The monsoon flow, combined with release of surplus water from the right bank canal of the Nagarjunasagar reservoir into the Chandravanka river (Fig. 1) keeps the waterfall discharge high up to December-January (Plate 1). Therefore, from July to December, the waterfall is usually under heavy discharge depending on rainfall and surplus water release. For the rest of the year (January to end of June) there is a modest water flow over the waterfall (Plate 2). This low water period also coincides with the nesting season of mugger which is March to April in this region.

Early February was considered the best time for release in order to give the captive-reared crocodiles a four month period to settle down and get acquainted with the habitat before the onset of monsoon and resultant floods. Meanwhile, during this dry period, the released crocodiles could be monitored easily and on the basis of these data, a broad, clear-cut monitoring programme could be formulated.

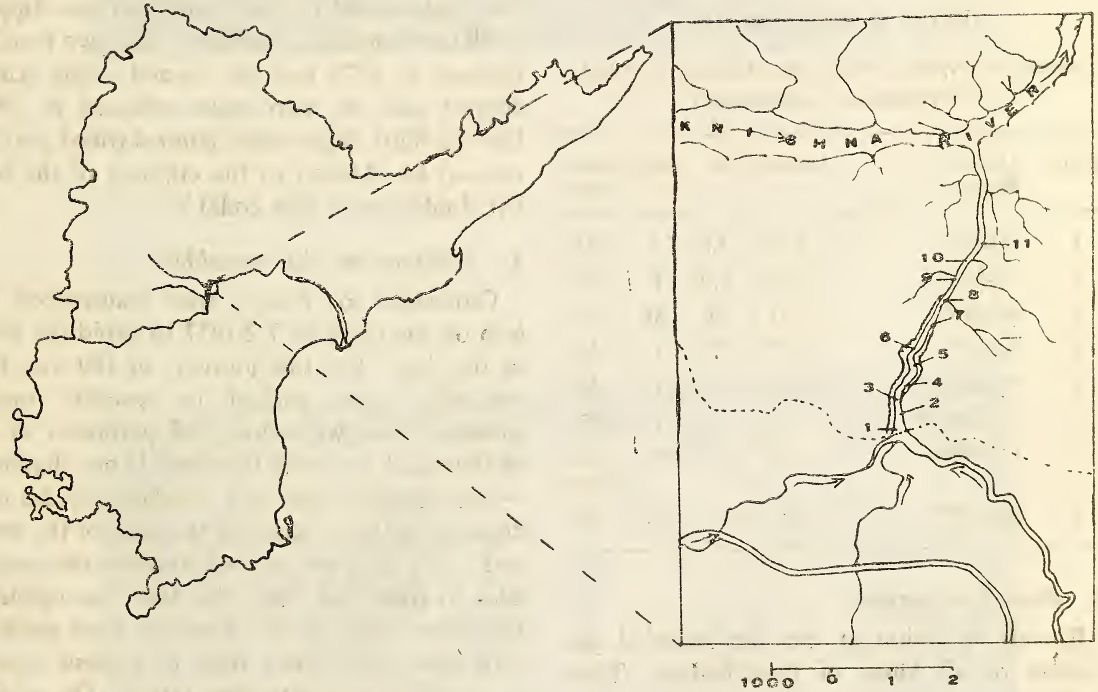

Fig. 1. Andhra Pradesh, showing the location of Nagarjunasagar Wild Life Sanctuary and inset showing the portion of the Sanctuary including Ethipothalla water falls on the Chandravanka River. The pools referred to in the text are numbered. Pool 1 is located immediately below the falls. Scale of inset in metres.

1 (c). *Selection of crocodiles for release*

At this time, Nehru Zoological Park, Hyderabad was rearing twelve wild caught juvenile mugger crocodiles—all caught in the nets of fishermen in the Krishna and Godavari rivers within the State. Four mugger, all above 1 m in size (Table 1) were chosen for release since it was considered that at this size crocodiles are capable of defending themselves. The group consisted of one male and three females. Subsequently, two more female mugger of 1975 year class, taken over from Nagarjunasagar P.W.D. were released and a further selection of two more males for release was made from the Nehru Zoological Park's collection (Table 1).

TABLE 1

DETAILS OF MUGGER RELEASED.

LENGTH (m) WEIGHT (KG), SEX (M-MALE) (F-FEMALE), APPROXIMATE AGE (MONTHS)

S.No.	Date of Release	Length	Wt.	Sex	Approx. Age
1	8-2-1977	1.08	5.0	F	32
2	8-2-1977	1.09	6.0	F	32
3	8-2-1977	1.11	6.0	M	32
4	8-2-1977	1.17	7.5	F	32
5	23-12-1978	1.52	..	F	42
6	23-12-1978	1.63	..	F	42
7	16-9-1980	1.90	22.5	M	not known
8	16-9-1980	1.63	18.0	M	69

2. *Pre-release actions*

Pre-release action at the site included prevention of all kinds of disturbances. These were :

(a) a ban on cattle and goat grazing below and near the fall and along the river banks.

(b) a ban on fishing of any kind in the habitat combined with a general ban on the use of the main pool below the fall for recreational purposes, like swimming and bathing etc. This was considered essential in order to avoid conflict between the crocodiles and people.

3. *Marking crocodiles for release*

Prior to release, the crocodiles were measured, sexed and marked for future identification. The marking method adopted was clipping of the enlarged scutes on the dorsal caudal region (Fig. 2). Males were clipped by removal (Plate 2) of the last left double caudal scute, looking at the animal from tail to head. No scute was clipped to indicate female sex. For the first year of release (1977), the first scute of the single scuted portion of the tail was clipped in all four released crocodiles. The two females released in 1978 had the second single scutes clipped and the two males released in 1980 had the third single scutes clipped (third year of release) in addition to the clipping of the last left double scute (sex code).[5]

4. *Transporting the crocodiles*

Crocodiles for release were transported by jeep on the night of 7-2-1977 to avoid the heat of the day. For this journey, of 180 km, the crocodiles were packed in specially made wooden crates with elongated partitions so as to allow each crocodile to remain in one chamber—each chamber was well ventilated by 2.5 cm diameter air holes made on the sides of the box, and had a door on one end to allow the crocodiles to come out when the door was opened. The inner walls of the chambers were padded with straw and gunny bags to prevent injury to crocodiles during transportation. On reach-

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[5] For details concerning the marking of crocodilians for release, see Bustard, H. R. and Choudhury, B. C. (1981).

Mugger habitat on the Chandravanka river below the Ethipothalla waterfall with a succession of rapids interspersed with deep pools.

Ethipothalla falls—monsoon level of water discharge.
(*Photos :* H. R. Bustard)

Ethipothalla falls during the lean season showing modest water discharge.

Clipping the second of the single scutes to identify year of release.
(*Photos* : H. R. Bustard)

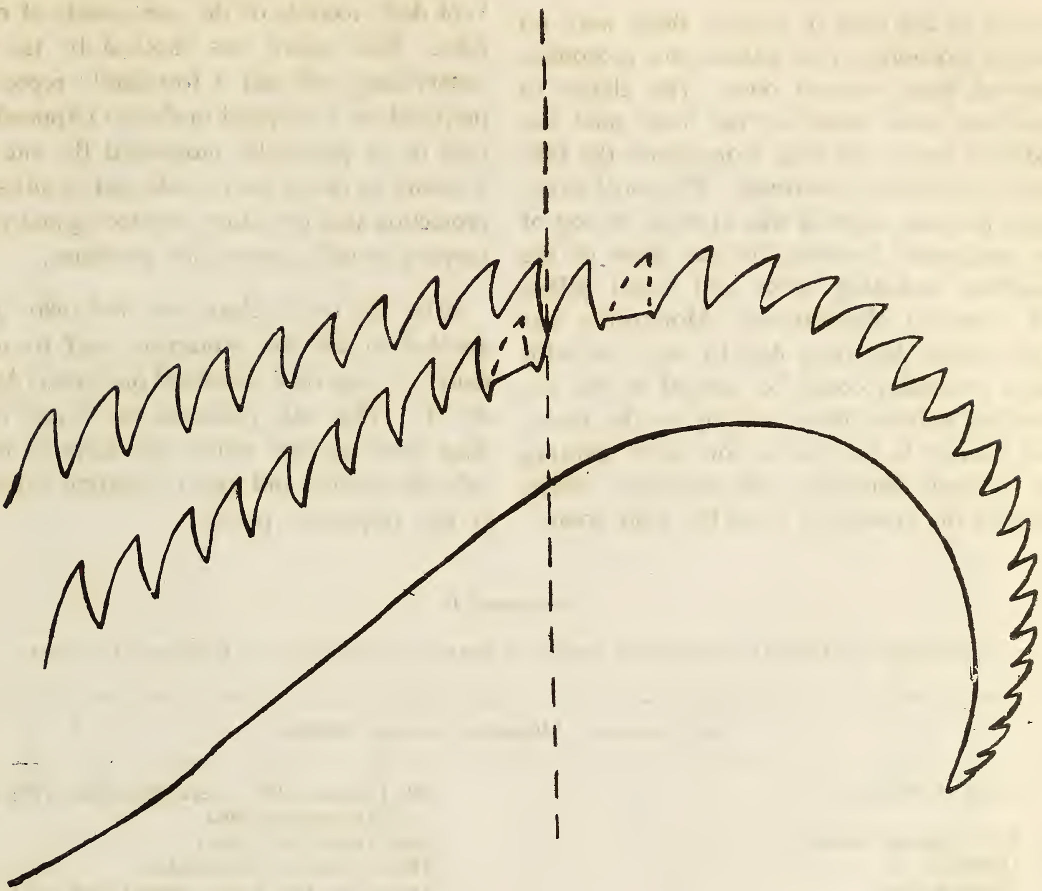

Fig. 2. Crocodile tail showing arrangement of double and single scutes. The dotted lines show the division between these. The last of the double scutes on the left hand side has been clipped denoting that the individual is a male. The second of the single scutes has also been clipped denoting year two release. In both cases the dotted portion of the scutes has been removed.

ing the destination, the crocodiles were kept in the shade well moistened until the release time.

5. *Actual release*

The initial release took place at 1700 hours on 8-2-1977. The crates containing the crocodiles were taken down to the main pool below the falls and kept with their door end facing the water. On opening the door of the crates, the crocodiles faced the water, and could come out of the box on to the bank of the pool. The time taken for the crocodiles to emerge varied from five to fifteen minutes.

Further releases of two female mugger on 23-12-1978 and two males on 16-9-1980 were carried out at the same spot.

MONITORING

Since at the time of release, there were no resident crocodiles in the habitat, any crocodiles observed were released ones. The ability to view four pools including the main pool immediately below the falls, from above the falls greatly facilitated monitoring. The usual monitoring practice adopted was to walk on top of the escarpment looking for any signs of the crocodiles including spoor and faecal pellets and recording observations. Monitoring was done during day time due to the ease with which crocodiles could be spotted in the undisturbed habitat often basking on the rocks. This habitat is not suited for night spotting due to many boulders and vegetation which obscured the crocodiles from the light source.

The guards appointed at the site for protection kept daily records of the movements of crocodiles. This record was checked by the local supervising staff and a fortnightly report was prepared on a supplied proforma (Appendix I). One of us personally monitored the site once a month to check the records and to advise the protection staff on future monitoring and record keeping as well as protection problems.

After the third release on 16-9-1980, it was decided to use the protection staff to record daily sightings on a simplified proforma (Appendix II). This only indicated the names of the deep pools against which they have to record only the number and time of sighting crocodiles in the respective pools.

APPENDIX I

FORTNIGHTLY/MONTHLY MONITORING REPORT OF RELEASED CROCODILES AT ETHIPOTHALLA FALLS

Species released—Mugger (*Crocodylus palustris*)

1. Dates of release	.. 8th February 1977, 23rd December 1978 and 16th September 1980
2. Total number released	.. Eight (four+two+two)
3. Details of sex	.. Three males and five females
4. Marking codes	.. Males last left double caudal scute and first or third single caudal scutes clipped. Females first or second single caudal scutes clipped.

To be filled in by the Observer

1. Date of Observation ..
2. Water level in the fall .. Low/Moderate/High
3. Weather condition .. Sunny/Cloudy/Rainy
4. Air temperature ..
5. Water temperature ..
6. Crocodiles observed (number, location etc.) ..
7. Average basking time of crocodiles for the day ..
8. Information on observations by local watchmen during last fortnight/month ..
9. Remarks/Suggestions of the observer ..

Date :

Signature of the observer

Name in full :

APPENDIX II

DAILY OBSERVATION PROFORMA (TO BE RECORDED BY LOCAL WATCHERS)

Date	Day	Time	POOLS											Weather			Remarks
			1	2	3	4	5	6	7	8	9	10	11	Sun	Cloud	Rain	
26-4-1981 ..	Sunday	AM	10.30	..	11.30	..	..	..	..	..	..	..	..	..	..	..	
		PM	..	..	..	..	..	..	..	..	..	..	..	..	3.00	Nil	
27-4-1981 ..	Monday	AM	11.15	..	..	..	..	..	..	..	..	..	..	..	√	Nil	
		PM	..	..	3.00	4.30	..	..	..	..	..	..	..	Nil	..	..	
28-4-1981 ..	Tuesday	AM	9.30	..	10.30	..	..	..	..	..	..	..	..	..	..	..	
		PM	..	..	..	3.15	..	..	4.45	..	..	..	..	√	Nil	Nil	
29-4-1981 ..	Wednesday	AM	10.00	..	11.15	..	..	..	..	..	..	..	..	..	..	..	
		PM	..	..	..	4.00	..	..	..	..	2.30	..	..	√	Nil	Nil	
30-4-1981 ..	Thursday	AM	9.00	..	9.30	11.15	..	..	..	..	..	..	..	..	..	..	
		PM	..	..	..	..	..	..	..	..	..	..	..	√	Nil	Nil	
1-5-1981 ..	Friday	AM	8.00	..	8.30	..	..	9.00	..	..	..	..	..	..	..	..	
		PM	..	..	..	..	..	..	..	..	3.00	..	..	√	Nil	Nil	
2-5-1981 ..	Saturday	AM	..	..	..	..	..	10.00	..	..	8.30	..	..	..	..	..	
		PM	3.30	..	4.00	12.00	..	..	..	..	..	..	..	√	Nil	Nil	

Name and signature of recorder

RESULTS

The results set out below are grouped under three headings ; survival, movement and growth.

Survival

The total number of crocodiles observed on each monitoring trip by one of us (BCC) is given in Table 2. Table 3 gives the crocodiles sighted by the supervisory staff in each monitoring trip, and in Table 4 the daily records of the local protection staff are set out for the month of January 1981. Combining the data from the three Tables, a clear picture of the survival of released mugger can be obtained. The supervisory monitoring and the research monitoring visits were mostly of one day's duration and allowed a maximum 5-6 hours observation at the release site. On the last 6 visits by us, the actual monitoring time has been reduced to 2-3 hours per visit. Despite the brief duration of these visits, it can be clearly seen from Table 2 that the 1977 released crocodiles were resighted regularly following the release. That all survived after rehabilitation to the wild from zoo life is apparent from the monitoring result of 8 February 1978 (a full year after release), when all four were again resighted. One year later (on 13 March 1979) five of the (then) six released crocodiles were resighted. Following release of a further two individuals on 16-9-1980 the maximum number sighted has been seven.

The monitoring data of the local staff is more complete (Table 4), with 5 individuals seen on a single day (January 3, 1981) and on several observations six individuals have been observed (Fig. 3). On 17th May 1981 the local staff sighted 7 (of the 8) crocodiles. Since the local protection staff were present most of the time and operate from both ends of the habitat, their monitoring was more complete and they have sighted seven out of eight crocodiles so far.

Though all the eight mugger released have never been observed on any one day, it is believed that the survival has been 100% and that all mugger have not been observed because attempts to cover the whole area on a single day for a longer observation period have not been made. Pending this, it can be definitely stated that seven out of the eight mugger have survived.

Movement

Taking the 1977 release first, it can be seen that extremely little movement occurred in the year following release. Two mugger showed movement of within 100 m, one moved 500 m downstream and returned to pool 1 and one female moved a distance of 800 m and took up residence in pool 5. One individual of the second release (December 1978) has been sighted in pool 11 at a distance of 3 km below the release site from September 1980, and the sighting of most, if not all, crocodiles on each monitoring trip provided clear evidence that movement out of the area had not taken place. With improvement of the monitoring work and further releases over the years, all areas below the falls have been mapped and their distance from the main release pool measured. Since the mugger cannot move upstream due to the high falls, movement only took place in one direction—downstream. The data indicate how far mugger crocodiles move downstream, either voluntarily or due to effect of monsoon floods. As has been described above, the release site consists of a series of deep pools and for our monitoring purpose, 11 pools have been mapped. The last pool is located at a distance of 3 km below the fall. The nearest pool to the main pool is only 50 m distant. All movements were restricted to this 3 km stretch even allowing for four monsoon floods (the 1977 monsoon following the first release was the worst in living memory extensively flooding the area.)

TABLE 2

MONITORING RESULTS OF RESEARCH STAFF. THE DISTANCE MOVED BY CROCODILES WHICH HAD MOVED DOWNSTREAM FROM THE MAIN POOL IS GIVEN IN METRES IN BRACKETS

Date	Total Number of crocodiles seen	Main Pool	Distance below main pool
1	2	3	4
1977			
25th March[1]	4	2	2 (100)
22nd April	3	2	1 (100)
17th May	4	2	1 (100), 1(50)
8th June	4	3	1 (300)
3rd July	3	2	1 (100)
8th August	3	2	1 (100)
9th October	4	2	2 (50)
23rd November	..	..	..
14th December	2	..	1 (100), 1(500)
1978			
28th January	2	2	..
8th February	4	3	1(800)
30th March	2	2	..
28th April	3	3	..
28th May	3	3	..
14th June	3	3	..
6th September	3	3	..
23rd December[2]	4	2	1 (500), 1 (200)
1979			
13th March	5	4	1 (50)
3rd April	3	3	..
11th August	2	2	..
17th November	2	2	..
1980			
13th January	3	2	1 (500)
21st February	3	3	..
3rd May	4	2	1 (400), 1 (100)
15th June	3	2	1 (400)
17th September[3]	2	1	1 (200)
9th November	3	1	1 (100), 1(800)
1981			
27th January	3	2	1 (500)
27th February	3	3	..

[1] Four crocodiles released.

[2] Two additional crocodiles released on 23-12-1978 increasing the total population to six individuals. On this date monitoring was carried out *prior* to this release and all four individuals sighted.

[3] Two additional crocodiles released on 16-11-80 increasing the total to 8.

TABLE 3

MONITORING RESULTS OF LOCAL SUPERVISORY WILD LIFE STAFF, CONDUCTED AT APPROXIMATELY FORTNIGHTLY INTERVALS, COVERING THE PERIOD 28 DECEMBER 1977 TO 1 SEPTEMBER 1980. THE DISTANCE MOVED BY CROCODILES WHICH HAD MOVED DOWNSTREAM FROM THE MAIN POOL IS GIVEN IN METRES IN BRACKETS

Date	Total number of crocodiles seen	Main Pool	Distance below main pool	Waterflow
1977				
28th December	..	..	..	Moderate
1978				
5th February	..	..	..	Moderate
9th March	2	2		Moderate
21st May	1	1		Low
24th May	2	2		Low
14th June	3	2	1 (500)	Moderate
11th August	3	3		Full
25th August	2	2	1 (500), 1 (100)	Full
22nd December	4	2		
1979				
6th January	4	3	1(500)	Moderate
18th January	3	3		Moderate
28th January	3	3		Low
3rd February	2	2		Low
11th February	4	4		Low
18th February	2	2		Low
9th April	2	2		Low
16th April	4	4		Low
23rd April	5	3	2 (600)	Low
6th May	3	3		Low
13th May	3	1	2 (600)	Low
20th May	5	3	2 (600)	Low
27th May	2	2		Low
3rd June	4	2	2 (600)	Low
12th June	5	3	2 (600)	Low
24th June	2	2		Low
10th July	3	3		Low
22nd July	4	4		Low
5th August	4	4		Low
12th August	3	3		Low
28th August	2	2		Low
11th September	1	1		Full
23rd September	2	2		Full
7th October	3	3		Moderate
14th October	3	3		Moderate
21st October	1	1		Moderate
28th October	2	2		Moderate
4th November	2	2		Moderate
19th November	2	2		Moderate
2nd December	3	3		Moderate

Date	Total Number of crocodiles seen	Main Pool	Distance below main pool	Waterflow
1980				
1st January ..	2	2		Moderate
16th January ..	3	3		Moderate
1st February ..	3	3		Moderate
16th February ..	2	2		Moderate
2nd March ..	2	2		Moderate
16th March ..	2	2		Low
1st April ..	2	2		Low
16th April ..	2	2		Low
1st May ..	2	2		Low
16th May ..	2	2		Low
1st June ..	2	2		Low
16th June ..	3	2	1 (100)	Low
1st July ..	2	2		Low
16th July ..	2	2		..
1st August ..	2	2		..
16th August ..	2	2		..
1st September ..	2	2		..

Growth

At the time of the first release of four mugger of estimated age 2 years 8 months, on 8th February, 1977, the average size was 1.11 m (Table 1). At the time of the second release of two mugger estimated to be three and a half years old, on 23rd December, 1978 (22 months after the first release), a footprint of the first released mugger was measured and from this it was estimated that the size of the mugger was 1.6 m (the possible error of estimation at this size is ± 5 cm). This indicated a growth rate of about 50 cm in 22 months by which time the mugger were approximately four and a half years old.

Thereafter, no further footprints have been measured, and size estimation has been carried out visually. On the day of the third release on 16th September 1980, (22 months after second release) the resident mugger were almost identical with the 1.9 m male released on that day. The growth rate, therefore, during the next 22 months, by which time the mugger were about six and a half years old, was about 30 cm. An overall growth of 80 cm, was recorded in 44 months, in the wild, for mugger between the approximate ages of two and a half years and six and a half years.

Breeding

The first wild breeding of these released mugger took place in 1981. The female, from the second release, which bred, was in her seventh year. A full account of this will be published in due course.

DISCUSSION

The importance of selecting an ideal release site cannot be overstressed. If this is wrongly chosen the release is doomed to failure. In order to give the released crocodilians every opportunity to adjust to and become acquainted with their new surroundings, prior to the onset of the monsoon, the release season is also of key importance. Crocodiles should be released in the early spring, at least three months prior to the commencement of the monsoon.

TABLE 4

MONITORING RESULTS BY THE LOCAL PROTECTION STAFF ON A DAILY BASIS. THESE RESULTS ARE GIVEN FOR JANUARY 1981 FOR COMPARISON WITH THE DATA IN TABLE 2. AN ASTERISK (S) INDICATE(S) THE SIGHTING OF A CROCODILE(S), THE TIME OF SIGHTING IS ALSO GIVEN. THE LOCATION REFERENCES ARE GIVEN IN THE TEXT AND IN FIGURE 1

Date (Jan. 1981)	Location											Total seen
	Main Pool 1	2	3	4	5	6	7	8	9	10	11	
1	**1545	..	..	*0900	..	..	..	..	*1200	..	..	4
2	*0930	..	..	..	..	..	*1200	..	..	..	*1600	3
3	*0900	..	..	*0945	..	..	*1200	..	*1400	..	*1600	5
4	*0900	..	..	*1000	..	..	*1330	..	..	..	*1600	4
5	*0930	..	..	*1100	..	..	..	..	..	..	..	2
6	*1000	..	..	*1030	..	..	..	..	..	*1545	..	3
7	*0900	..	..	..	..	..	*1100	..	*1500	..	..	3
8	*0930	..	..	..	..	..	*1200	*1230	..	..	..	3
9	..	..	..	..	..	..	*1400	..	..	..	*1600	2
10	**0945	..	..	*1030	..	..	..	..	..	*1600	..	4
11	*0900	..	..	*1000	..	..	..	..	..	..	..	2
12	**1100	..	..	*0930	..	..	..	*1500	..	..	..	4
13	**1545	..	..	*1000	..	..	..	..	..	..	*1600	3
14	*1000	..	*1500	..	..	..	..	..	*1530	..	..	4
15	**1230	..	*1600	..	..	..	..	..	..	..	..	3
16	**1600	*1530	..	*1000	..	..	..	..	..	..	..	4
17	**1045	..	*1200	*1400	..	..	..	..	..	..	..	4
18	**1100	..	..	*1230	..	*1400	..	*1500	*1630	..	..	6
19	*0900	..	..	..	*1100	..	*1300	..	..	*1600	..	4
20	**1200	..	..	*1430	..	..	..	..	*1500	..	..	4
21	**0800	..	..	*1000	..	..	*1200	..	..	..	..	4
22	*0930	..	..	*1100	..	..	..	..	*1400	..	..	3
23	*1000	..	..	..	..	*1400	..	..	..	..	*1600	3
24	**1130	..	..	*1230	..	..	..	..	*1630	..	..	4
25	*0900	..	..	*1030	..	..	..	..	..	..	..	2
26	*0930	..	..	*1000	..	..	..	..	*1500	..	..	3
27	**1200	..	..	*1500	..	..	..	..	..	..	..	3
28	*1500	..	..	..	..	..	..	..	..	..	..	1
29	*1000	..	..	*1130	..	..	..	..	..	..	..	2
30	**1500	..	..	*1000	..	..	..	..	..	..	*1530	4
31	*1000	..	..	..	..	..	..	..	..	..	..	1

The best size for release also requires discussion. It is possible with mugger crocodiles, for instance, to release individuals much smaller than the 1.1 m size used here. Singh (1976) reported on two mugger of 56 and 41 cm respectively, which escaped from their hatchling pool into the adjacent Mahanadi river (Orissa) during October 1975. Both survived and are still there today. The release sizes recommended here, of 1.0-1.2m, is that for which we feel the survival rate will be high under all conditions throughout the country. There are a number of good reasons for selecting this size. There are also doubts that small mugger will show good survival at least in certain habitats as they will be unable to defend themselves from all predators. Burrow construction is also important in the mugger as a means of avoiding extremes of both heat and cold. Animals of below 1.2 m have not been observed digging burrows (B.C. Choudhury, unpubl. observ.). Further below 80 cm, it is

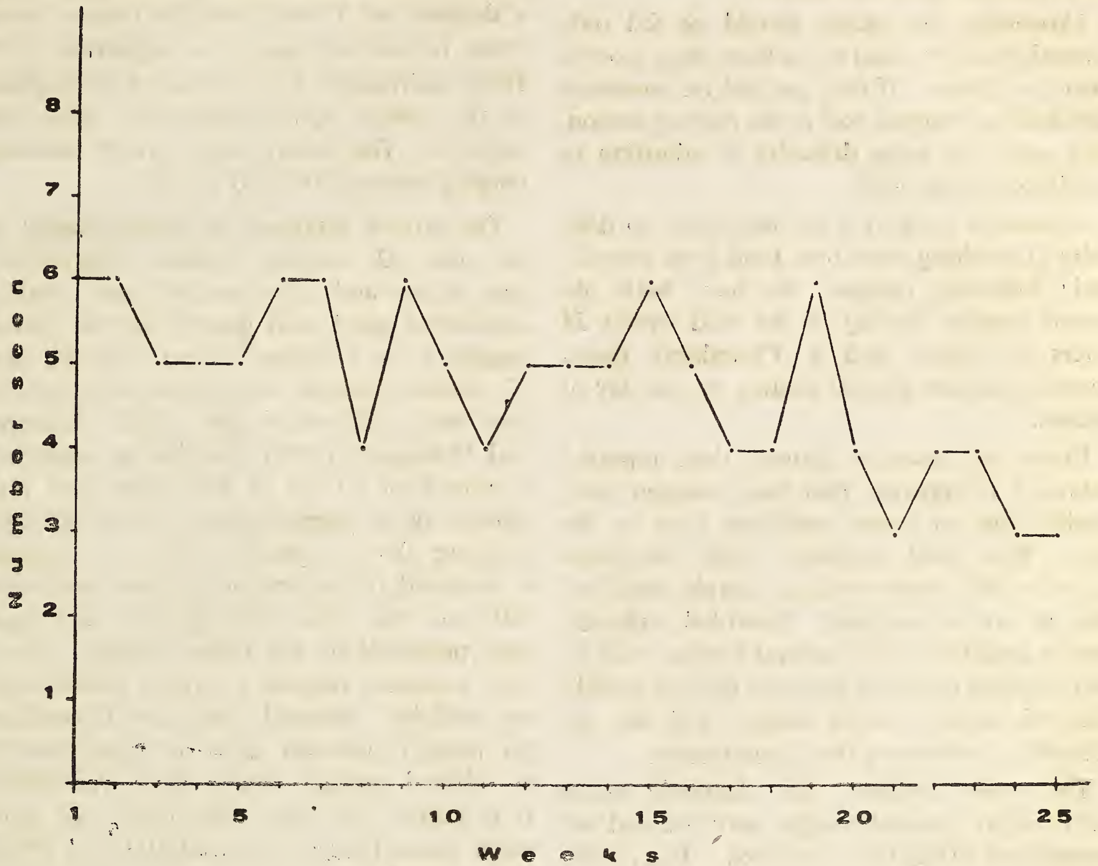

Fig. 3. Daily maxima for crocodile sightings plotted on a weekly basis for the period 29 September 1980 to 7th March 1981. The form of this plot does *not* indicate a falling trend in numbers observed. The apparent fall in February/March is due to the heat of the summer when the crocodiles remain mostly in the water making observation difficult. Furthermore, 7 individuals were seen on 17th May, 1981, a higher figure than that recorded since the study has commenced.

not possible to reliably sex mugger using the cloacal probing technique.

It is essential that the protection staff are appointed prior to the release in order not to lose valuable data (see below).

Crocodiles for release should be fed only natural food (live fish) for at least three months prior to release. If they are fed on unnatural diet such as chopped beef in the rearing station, they may face some difficulty in adjusting to conditions in the wild.

Crocodiles used to a fish diet have no difficulty in catching their own food even immediately following release. We have both observed mugger feeding in the wild within 24 hours of release and S. Choudhury (pers. comm.) has seen gharial feeding on the day of release.

From the excellent growth data reported below, it is apparent that these mugger were readily able to secure sufficient food in the wild. This food included small mammals as well as fish, from the faecal samples collected but yet to be analysed. Provided sufficient food is available in the natural habitat, that is, that the food resources have not become unduly depleted, captive reared mugger will face no difficulty in obtaining their requirement.

The results indicate that definitely seven out of eight released mugger survived and we suspect that all eight have survived. This result, in itself, demonstrates the validity of the 'rear and release' technique.

We believe that given the ideal conditions, in undisturbed natural habitats, mugger move very little, if at all. This belief is also borne out by the results of this pilot release. The release point is 5 km upstream from the junction of the Chandravanka river with Krishna river. Even despite the massive floods of 1977, none of the mugger ever went down to the Krishna during the four years covered by this study. The maximum distance moved by individuals of the first release was by one female which moved 800 m downstream in 1978 (the year following release). The female has subsequently remained at this site. A female of the December 1978 release, moved to pool 11, a distance of 3 km from the release point, where it was first sighted in September 1980. Three individuals have remained throughout in the release spot immediately below the waterfall. The others have moved distances ranging between 500 m to 1.5 km.

The growth reported, of approximately 50 cm over 22 months, between approximate ages of two and a half to four and a half is considered good wild growth for the Indian mugger as is a further 30 cm over the next 22 months between the approximate ages of four and a half to six and a half. Acharjyo and Mohapatra (1978) recorded on recapture, a growth of 50 cm in four years and nine months in a mugger that lived in the wild escaping from captivity. When it escaped it measured 170 cm and on recapture measured 220 cm. No other wild growth data have been published on the Indian mugger. However, extensive (unpubl.) captive growth data are available. Bustard, Singh and Choudhury (in prepn.) provided data on rapid growth in selected mugger strains from Tamilnadu. It is known that such individuals can grow much faster than in the wild (Bustard 1980). These rapid growing captives increased by about 65 cm, during the same period that the wild mugger here described increased by 50 cm. In the 5th year the captive mugger grew by 30 cm, whereas the wild individuals took two years to show this length increase from four and a half to six and a half years of age.

Data collected from the pilot release and monitoring of mugger crocodiles at Ethipothalla falls provided the Andhra Pradesh Crocodile Project the required informational basis for further releases. Other than confirming most of the hypothesis on mugger behaviour, survival, movement and growth, the pilot release also provided opportunity to evolve a good monitoring system and to train personnel on management methodology. Furthermore, such small pilot releases prevented the risk of large-scale, unsuitable release of mugger that are produced in rearing stations with maximum effort and expenditure. Most important of all, resources like rare species of crocodilians should not be allowed to be wasted by unplanned releases.

ACKNOWLEDGEMENTS

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STUDIES ON THE ESTUARINE ODONATA FROM 24 PARGANAS DISTRICT OF WEST BENGAL, WITH A NOTE ON THE RE-PRODUCTIVE BEHAVIOUR IN *UROTHEMIS SIGNATA SIGNATA* (RAMBUR) (ODONATA : INSECTA)[1]

M. Prasad and S. K. Ghosh[2]

(*With six text-figures*)

INTRODUCTION

Dragonfly fauna of West Bengal, specially from the estuarine area is inadequately known which is evident from the works of Fraser (1933, 1934 and 1936), Bhasin (1953) and Mitra *et al.* (1976). However, Fraser and Dover (1922) and Laidlaw (1921) have recorded 30 species of Odonata from the saline and semi-saline areas of Barkuda Islands in Chilka lake. To fill this lacunae, we made an extensive collection of Odonata from Diamond Harbour (Diamond Harbour and Sonadanga), Fraserganj (Amrawti, Bakkhali and Fraserganj) and Kakdwip (Gangadharpur, Kakdwip and Trilokchandpur) in 24 Parganas district of West Bengal (Fig. 1).

The material includes specimens of 23 species (8 belonging to suborder Zygoptera and 15 to suborder Anisoptera) from the estuarine areas of 24 Parganas. Most of the species agree fairly well with the descriptions of Fraser (l.c.). Differences wherever noted from the published descriptions have been recorded under various species. Specimens of *Pantala flavescens* (Fabricius) were observed on wing at Diamond Harbour, but we were unable to collect them. In addition, some interesting observations on the reproductive behaviour in *Urothemis signata signata* (Rambur), made from a permanent monsoon pond at Paikpara, Calcutta, are reported in the present paper.

SYSTEMATIC ACCOUNT

Order	..	ODONATA
Suborder	..	ZYGOPTERA
Family	..	COENAGRIONIDAE

1. **Pseudagrion microcephalum** (Rambur)

Material : 1♂, Diamond Harbour, 5-6-1978.

Remarks : Agree fairly well with the published description, except 9 postnodal nervures in forewings and 8 in hindwings.

2. **Pseudagrion decorum** (Rambur)

Material : 1♂, 1♀, Fraserganj, 31-5-1978.

3. **Ceriagrion coromandelianum** (Fabricius)

Material : 1♀, Amrawti, 3.6.1978 ; 1♂, Fraserganj, 31.5.1978 ; 1♂, Kakdwip, 27.5.1978 and 1♂, Sonadanga, 6.6.1978.

Remarks : Commonly available on both permanent and temporary waterbodies, and can be collected in large numbers without much effort.

4. **Ceriagrion cerinorubellum** (Brauer)

Material : 2♂♂, Amrawti, 3.6.1978 and 1♂, Trilokchandpur, 28.5.1978.

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[1] Accepted April 1979.

[2] Zoological Survey of India, Calcutta.

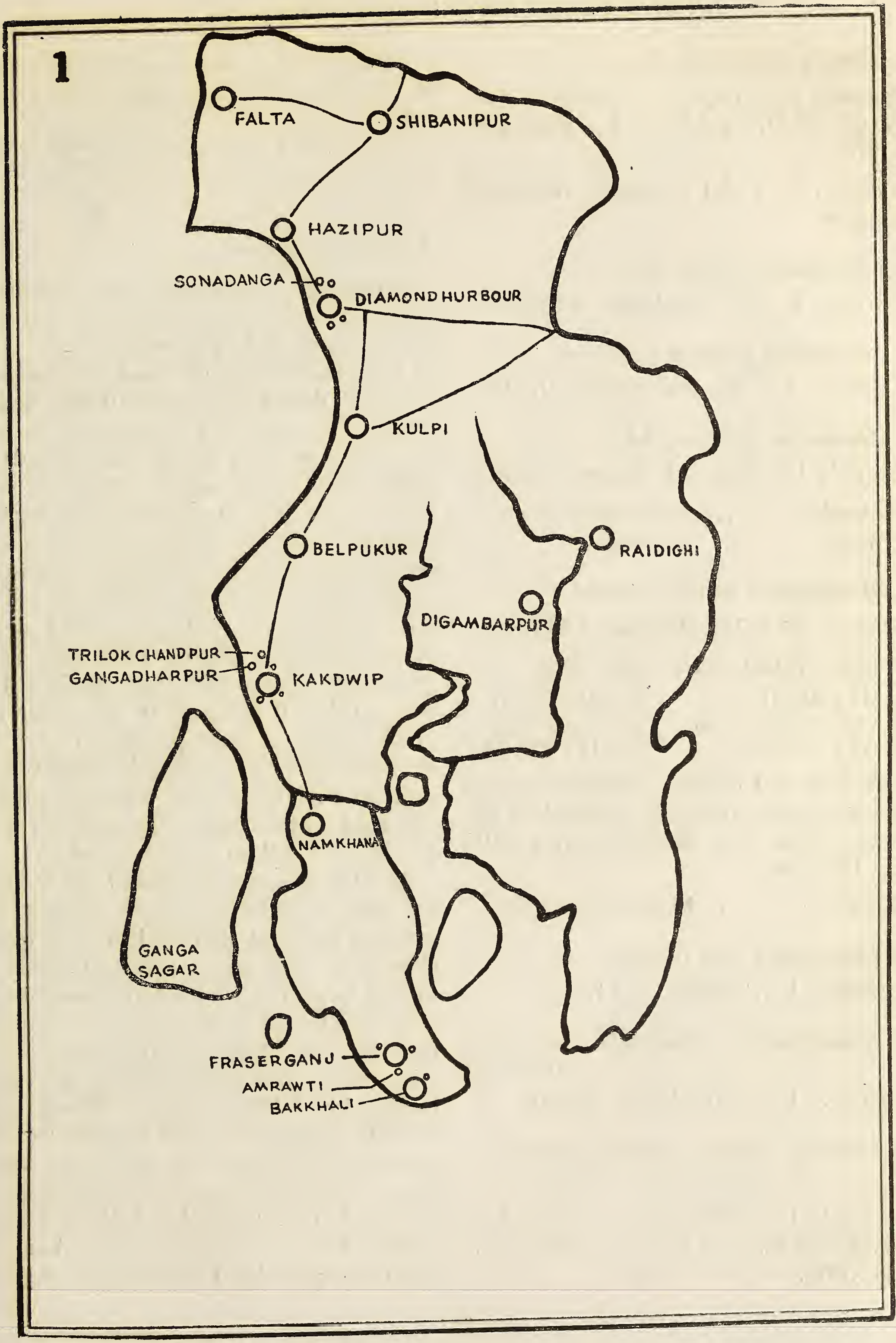

1
FALTA
SHIBANIPUR
HAZIPUR
SONADANGA
DIAMOND HURBOUR
KULPI
BELPUKUR
RAIDIGHI
DIGAMBARPUR
TRILOK CHAND PUR
GANGADHARPUR
KAKDWIP
NAMKHANA
GANGA SAGAR
FRASERGANJ
AMRAWTI
BAKKHALI

Fig. 1. Map of Diamond Harbour, Fraserganj and Kakdwip of 24 Parganas district (West Bengal) showing collection sites.

5. **Ischnura senegalensis** (Rambur)

Material: 1♂, Amrawti, 3.6.1978; 3♂♂, Bakkhali, 2.6.1978 and 3 ♂♂, 1♀, Fraserganj, 31.5.1978.

Remarks: It is also commonly distributed in this area.

6. **Agriocnemis lacteola** Selys

Material: 2 ♂♂, Sonadanga, 6.6.1978.

7. **Agriocnemis pygmaea** (Rambur)

Material: 1♂, 1♀, Fraserganj, 31.5.1978.

8. **Onychargia atrocyana** Selys

Material: 1♂, Diamond Harbour, 5.6.1978.

Suborder .. ANISOPTERA
Family .. GOMPHIDAE

9. **Ictinogomphus rapax** (Rambur)

Material: 2♂♂, 2♀♀, Bakkhali, 1.6.1978.

Remarks: Nodal index varies from

$$\frac{11-21 \mid 20-11}{12-15 \mid 15-13} \quad \text{to} \quad \frac{14-22 \mid 24-14}{15-17 \mid 20-14}$$

in both male and female. Specimens of this species were most commonly observed on the semisaline ponds near Bakkhali during 08.00 hrs. to 14.00 hrs.

Family .. MACRODIPLACTIDAE

10. **Macrodiplax cora** (Brauer)

Material: 1 ♂, Amrawti, 3.6.1978.

11. **Aethriamanta brevipennis brevipennis** (Rambur)

Material: 1 ♀, Sonadanga, 6.6.1978.

12. **Urothemis signata signata** (Rambur) (Figs. 2-6)

Material: 1 ♀, Bakkhali, 1.6.1978; 1 ♀, Sonadanga, 6.6.1978 and 1 ♂, 1 ♀, Trilokchandpur, 28.5.1978.

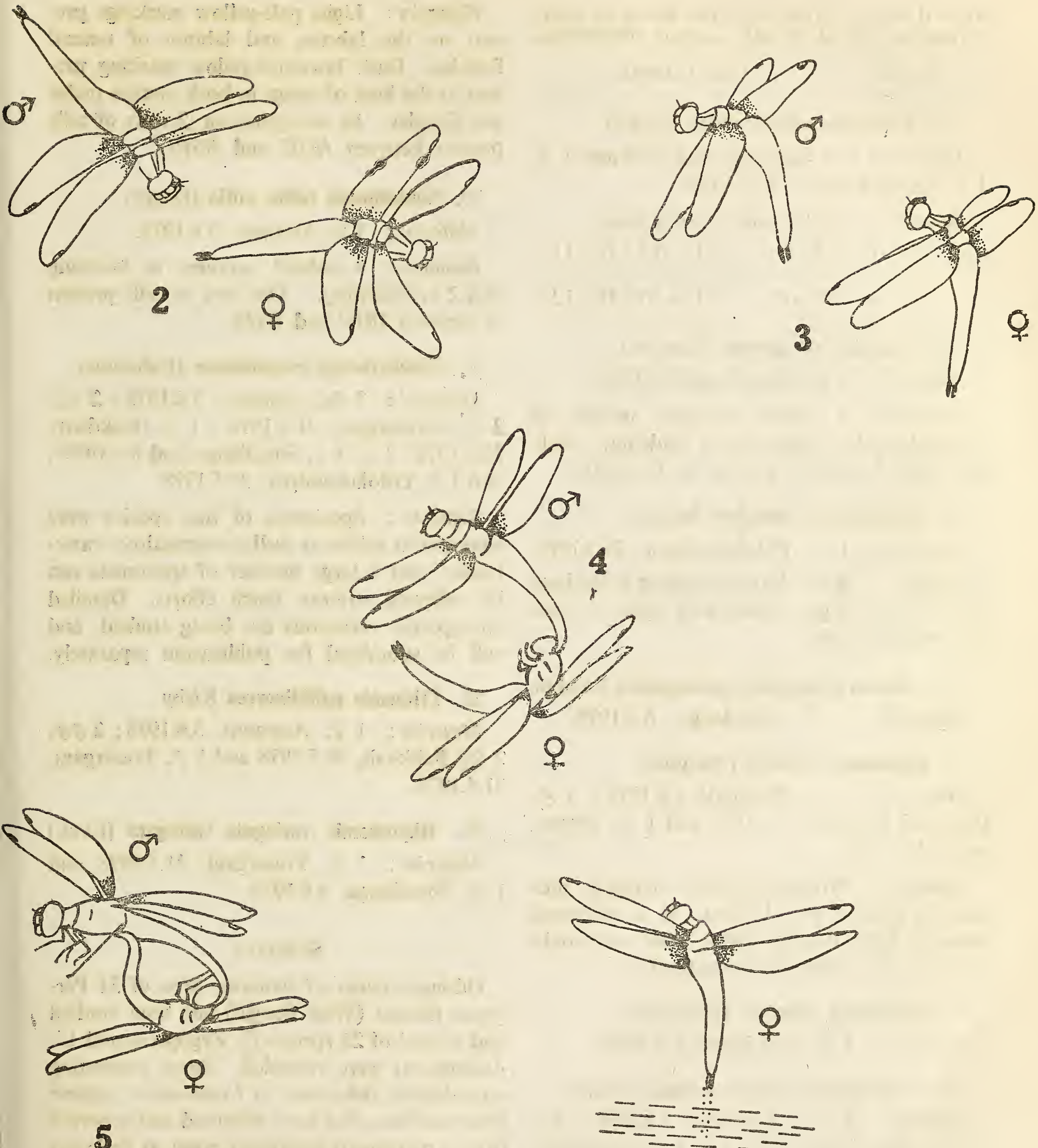
Remarks: It is also a very common species in this area. Male has nodal index numbering

$$\frac{8-7 \mid 7-7}{8-5 \mid 5-8}$$

Reproductive behaviour:

Reproductive behaviour in *Urothemis s. signata* (Rambur) was observed several times in the month of August and September, 1978, at a permanent monsoon pond near Paikpara, Calcutta, during the sunny days. A large number of males and females can be easily seen there on wing during these periods. A male, which used aquatic plants or other twigs as its base perch was seen regularly flying within an area of 70 cm to 1.80 m of the pond, which marked its territory. It sometimes made flights outside its territory as well but not far from it. Abdomen raising display [=threat posture (Moore 1960) and obelisk posture (Corbet 1962)] was performed by male, to defend intrusion of any other male in the territory. It was peculiar to note, that, if a male of other species already perched earlier, then the territory was not defended, unless it interfered. Male makes regular flights within the territory and sometimes outside it.

As soon as a female entered the territory, the male immediately started chivying, even when on the wing, and tried to form tandem (Figs. 2-4). Subsequently copulation wheel was formed by the pair within 5 to 10 seconds, and continued for 35 seconds (Fig. 5). Duration between each break of copulation wheel, in this species, varies from 28 to 46 seconds (observed in 6 different pairs). Female moved towards oviposition site, and after a few seconds, started egg laying in the water near aquatic plants and weeds (Fig. 6). Oviposition was continued for 5-12 seconds. Male tried several times to form the copulation wheel during the oviposition period and ultimately the wheel was



Figs. 2-6. Reproductive behaviour of *Urothemis signata signata* (Rambur) (2-3 Male-female precopulatory position, 4. Male-female tandem, 5. Male-female copulation wheel, 6. Female starting oviposition).

formed twice. Soon after the break of every copulation wheel, female started oviposition.

Family .. LIBELLULIDAE

13. **Orthetrum sabina sabina** (Drury)

Material: 1 ♀, Bakkhali, 30.5.1978 and 1 ♂, 1 ♀, Gangadharpur, 27.5.1979.

Remarks: Nodal index varies from

$$\frac{11\text{—}13 \mid 12\text{—}9}{11\text{—}10 \mid 10\text{—}10} \text{ to } \frac{11\text{—}12 \mid 12\text{—}11}{10\text{—}10 \mid 10\text{—}12}.$$

14. **Brachydiplax sabrina** (Rambur)

Material: 1 ♂, Sonadanga, 6.6.1978.

Remarks: 2 cubital nervures present in 1 left side and in right side of hindwing. Only one cubital nervure present in forewing.

15. **Brachydiplax chalybea** Brauer

Material: 1 ♂, Trilokchandpur, 28.5.1978.

Remarks. Burnt-brown marking at the base of both the wings extends only upto the first antenodal nervures.

16. **Acisoma panorpoides panorpoides** Rambur

Material: 1 ♂, Sonadanga, 6.6.1978.

17. **Diplacodes trivialis** (Rambur)

Material: 1 ♂, Bakkhali, 1.6.1978 ; 1 ♂, Diamond Harbour, 7.6.1978 and 1 ♂, Fraserganj, 31.5.1978.

Remarks: Brownish-yellow marking present in labrum and labium. It is attracted towards light during night, and commonly seen on the semisaline waterbodies.

18. **Diplacodes nebulosa** (Fabricius)

Material: 1 ♀, Sonadanga, 6.6.1978.

19. **Crocothemis servilia servilia** (Drury)

Material: 2 ♀♀, Amrawti, 3.6.1978 ; 1♂, 2 ♀♀, Bakkhali, 30.5.1978 ; 1 ♂, 1 ♀, Fraserganj, 31.5.1978 and 1 ♂ Sonadanga, 6.6.1978.

Remarks: Light pale-yellow markings present on the labrum and labium of teneral females. Dark brownish-yellow marking present at the base of wings in both mature males and females. In one specimen, 2 rows of cells present between *IRIII* and *RSPL*.

20. **Neurothemis tullia tullia** (Drury)

Material: 1 ♀, Amrawti, 3.6.1978.

Remarks: 4 cubital nervures in forewing and 2 in hindwing. One row of cells present in between *IRIII* and *RSPL*.

21. **Brachythemis contaminata** (Fabricius)

Material: 2 ♂♂, Amrawti, 3.6.1978 ; 2 ♂♂, 2 ♀♀, Fraserganj, 31.5.1978 ; 1 ♂, Kakdwip, 27.5.1978 ; 1 ♂, 1 ♀, Sonadanga and 6.6.1978 ; and 1 ♂, Trilokchandpur, 28.5.1978.

Remarks: Specimens of this species were common at saline as well as semisaline waterbodies, and a large number of specimens can be collected without much efforts. Detailed intraspecific variations are being studied, and will be submitted for publication separately.

22. **Trithemis pallidinerves** Kirby

Material: 1 ♀, Amrawti, 3.6.1978; 2 ♂♂, 2 ♀♀ Bakkhali, 30.5.1978 and 1 ♂, Fraserganj, 31.5.1978.

23. **Rhyothemis variegata variegata** (Linn.)

Material: 1 ♀, Fraserganj, 31.5.1978 and 1 ♀, Sonadanga, 6.6.1978.

SUMMARY

Odonata fauna of estuarine area of 24 Parganas district (West Bengal) has been studied and a total of 23 species (8, Zygoptera and 15, Anisoptera) were recorded. Some interesting reproductive behaviour in *Urothemis s. signata* (Rambur) has also been observed and reported from a permanent freshwater pond at Paikpara in Calcutta.

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DISTRIBUTION, FEEDING HABITS AND BURROWING PATTERNS OF *TATERA INDICA CUVIERI* (WATERHOUSE)[1 & 2]

C. M. GEORGE, P. J. JOY AND C. C. ABRAHAM[3]

(*With two text-figures*)

A survey of the distribution of *Tatera indica* revealed that *T. i. cuvieri* is present throughout Kerala. The burrow system followed no definite patterns being either short, simple or elongated and winding. Each burrow system showed a minimum of three openings and there was no evidence of grain hoarding. The nesting materials inside the burrows consisted of dry teak leaves, dry grasses, dry leaves of *Terminalia paniculata*, dry rubber leaves, dry cowpea shoots, coconut root-bits, and dry stems of *Eupatorium odoratum* depending on the vegetation around the burrow location. In Kerala, these rats cause damage to tapioca, pulses, paddy, jowar and ginger crops.

INTRODUCTION

Information on the distribution and burrow patterns of rat species is an important prerequisite for successful implementation of control programmes. Extensive surveys of the distribution of rats in Kerala have not been conducted so far. In order to obtain detailed information on the structural features of the burrow pattern of *T. indica* occurring in diverse conditions and to study their relative abundance, a survey was conducted in the State during September, 1978 to February, 1979.

MATERIALS AND METHODS

For the survey work, the State was divided into eight agro-climatic zones and in each zone, four representative areas were selected (Table 1).

The burrow patterns were studied by first locating the emergency escapes by random probing with a crow-bar in a specific direction along the burrow, following the location of the soil-crest. Around the emergency escape, the soil easily crumbled down and such areas were immediately sealed off by compaction. Additional emergency escapes if any were then marked out by observing whether the rats escape from the burrow system consequent on smoking. For smoking, all the burrow entrances other than the principal one, was closed initially by putting rubble and by compacting the areas around the openings. Smoke was then let into the burrow system through the main entrance by burning tightly tied sheaves of dry coconut leaflet-strips of about 40 cm length, which were inserted into the burrow entrance. The burning end was fanned continuously to ensure steady inflow of smoke stream through the other end and thus to induce asphyxiation of rats inhabiting the burrows.

The entire burrow net-work was then exposed by gently working with crow-bar and spade, and the internal structuring of burrow system and details of the brood chamber/chambers and the food chamber/chambers were studied. The depth of the different regions of the burrow systems were also recorded.

The nature of damage caused by *T. indica* was studied by examining the stand of the

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[2] Part of the M.Sc. (Ag.) thesis submitted to the Kerala Agricultural University by the senior author for the award of the M.Sc. (Ag.) Degree.

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TABLE 1

DETAILS OF AGRO-CLIMATIC ZONES SELECTED FOR SURVEY WORK

S.No. of zone	Zones	Localities selected for survey work
1.	Trivandrum and Quilon districts	Vellayani, Attingal, Varkala, Adoor.
2.	Kottayam and Alleppey districts	Ettumannur, Kurianadu, Moncompu, Kidangara.
3.	Idukki and Ernakulam districts	Muthalakodam, Moolamattom, Perumbavoor, N. Parur.
4.	Trichur and Malappuram districts	Vellanikkara, Pattikkadu, Tavanur, Ponnani
5.	Palghat district	Melarkode, Nemmara, Thiruvazhiyodu, Vadakumcheri.
6.	Attappady in Palghat district	Thavalam, Chundukulam, Koolikadavu, Aanakatty.
7.	Wynaad in Calicut district	Kuppamudi, S. Battery, Meenangadi, Kalpatta.
8.	Cannanore district	Thirumeni, Cherupuzha, Aravanchal, Vellirikundu.

crop around the burrow location. The remnants of partially fed food materials recovered from the burrow were recorded as an index of the normally preferred food articles.

RESULTS AND DISCUSSION

T. i. cuvieri was found to be the only subspecies occurring in Kerala. The populations were relatively heavier throughout the State, excepting parts of Wynaad region in the Kozhikode District and parts of the Cannanore District. This is in conformity with Ellerman's (1961) report that in South India, *T. indica* populations consists mostly of *T. i. cuvieri.*

These rats were found in a wide range of habitats such as in crop fields, backyards of houses, thick grass growth, teak plantations and in waste lands. Krishnakumari (1968) recorded somewhat similar habitats for the species. However, the present observation is not in accordance with the report of Srinivasachar (1972) who stated that these rats were found only in crop fields along the bunds. The habitat variations may be attributed to the differences in the geographic features of the localities.

A total of twelve burrow systems of *T. i. cuvieri* were studied and these were of two basic types, namely, short simple and those with extensive ramifications. The structural details and other pertinent information of these two basic types of burrow systems are furnished in Table 2 and depicted in figures 1 and 2.

Pingale *et al.* (1967) reported that the burrows of *T. indica* were elongated consisting of winding passages, numerous emergency escapes and a breeding or living chamber located in the centre. In the present studies, it was found that certain burrows were quite simple in construction, while in certain other cases, the construction was quite complicated and extensive with winding passages. Another marked deviation from the previous reports is that the brood chamber/living chamber is not always centrally located.

Yashoda (1968) indicated that the live burrow systems of *T. indica* can be traced out by the presence of beaten pathways from one opening to the other and by the left over bits of leaves and slender branches across their runs. The present study clearly revealed, for the first time, that the presence of a soil plugging within the burrow close to the opening is the definite and reliable indication to the presence of live rats within the burrow.

TABLE 2

STRUCTURAL FEATURES OF BURROW SYSTEMS OF *T. i. cuvieri*

	Burrow System-1 (Simple type)	Burrow System-2 (Elongate, extensively ramifying type)
Location :	Melarkode	Aravanchal
Period of excavation	November 1978	January 1979
Nature of vegetation in the immediate vicinity	Coconut, banana and mango	denuded, rocky grassland.
Nature of soil	Laterite	Gravelly
No. of openings including emergency escapes	Three	Six
No. of emergency escapes	One	Two
Total horizontal profile dimensions	2.9 × 2 m.	4. 95 m^2.
Total length of the burrow system	4.94 m.	20.3 m.
Burrow width	Range 5-20 cm.	7-20 cm.
No. of brood chambers	One	One
Depth of brood chamber	34 cm.	31 cm.
Nature of nesting material	Dry leaves of *Terminalia paniculata*	Dry grasses
No. of blind alleys	One	Four
No. of soil pluggings	Two	Three
Nature of opening for removal of excavated soil.	Open	Closed and filled with soil
No. of adults and young ones captured from the burrow system	Mother and four young ones	One male, mother rat and four young ones
Basic shape of the burrow	'Y' shaped	No definite shape

In all the burrows, a minimum of three openings including the emergency escape were observed and this is in agreement with the earlier report of Barnett and Ishwar Prakash (1975). However, Yashoda (1968) had reported two to four openings while Bindra & Prem Sagar (1975) observed that there were one to ten surface openings. The soil dug out during burrow construction was found to be thrown out only through a particular opening and this phenomenon is reported for the first time. Bindra & Prem Sagar (op. cit.) found that certain surface openings of *T. indica* burrow systems were blocked with a small quantity of soil and these were used only in emergency for escape. In the present study such blocked surface openings were not observed in any of the systems. The burrow leading to emergency escape terminates abruptly, 1-3 cm below the soil surface, leaving a thin crust of soil cover which is pushed off in emergencies.

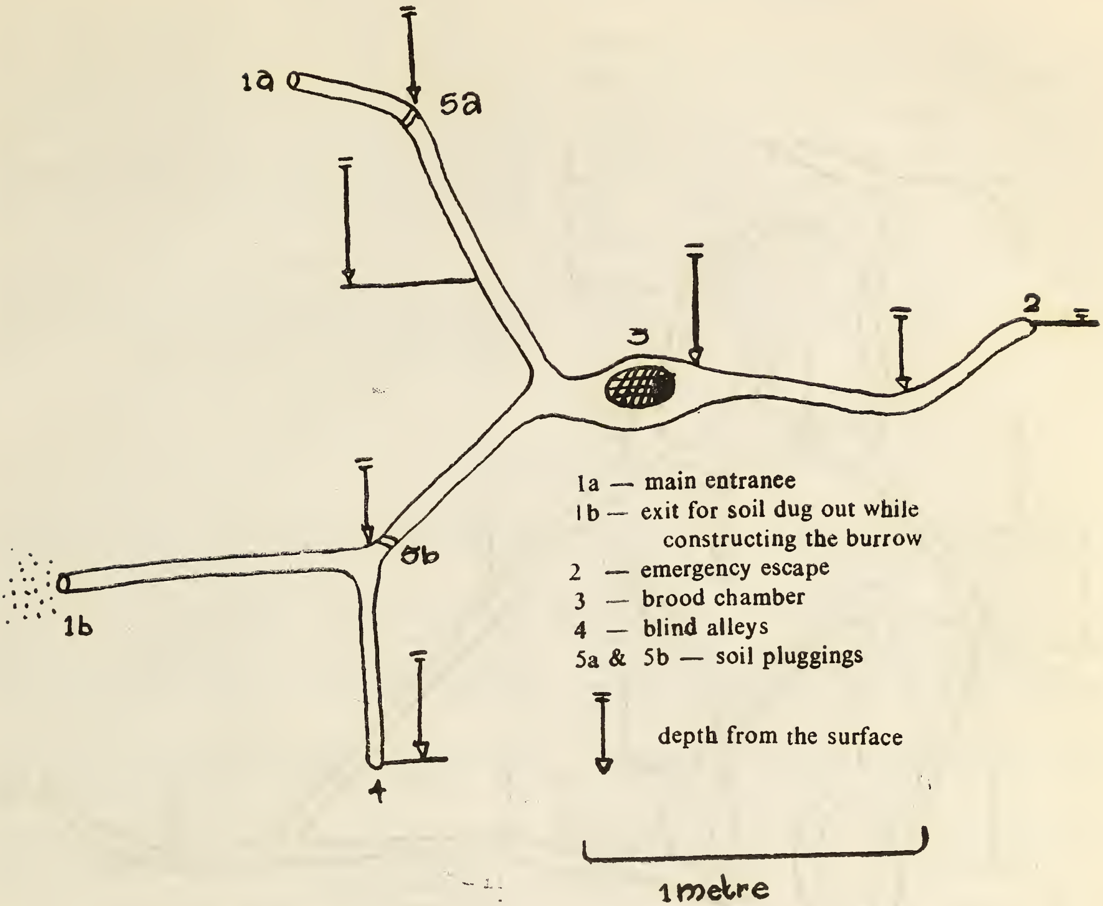
1a
5a
3
2
1b
5b
4
1a — main entrance
1b — exit for soil dug out while constructing the burrow
2 — emergency escape
3 — brood chamber
4 — blind alleys
5a & 5b — soil pluggings
depth from the surface
1 metre

Fig. 1. Burrow system (simple type) of *Tatera indica cuvieri.*

The nesting materials used inside the burrows consisted of the following ; depending on the nature of vegetation in the vicinity of the burrow :
(1) dry teak leaves (2) dry grasses (3) dry leaves of *Terminalia paniculata* (4) dry rubber leaves (5) dry cowpea shoots (6) bits of coconut roots and (7) dry stems of *Eupatorium.*

In a few cases mixtures of these articles were found in some nests.

The nesting materials previously reported include hay and leaves (Yashoda 1968) and grasses (Srinivasachar 1972).

Only one to three adults could be collected from a single burrow system as against one to five adults reported by Sundara Bai (1972). The occurrence of relatively more number of *T. indica* (upto twelve) in the burrows is reported by Yashoda (1968) and Barnett & Ishwar Prakash (1975).

The studies on the nature of damage by *T. i. cuvieri* revealed that in Kerala, tapioca, pulses, rubber seeds, paddy, jowar and cotton were the food crops preferred by this sub-species. It was also noted that the ginger crop is subject

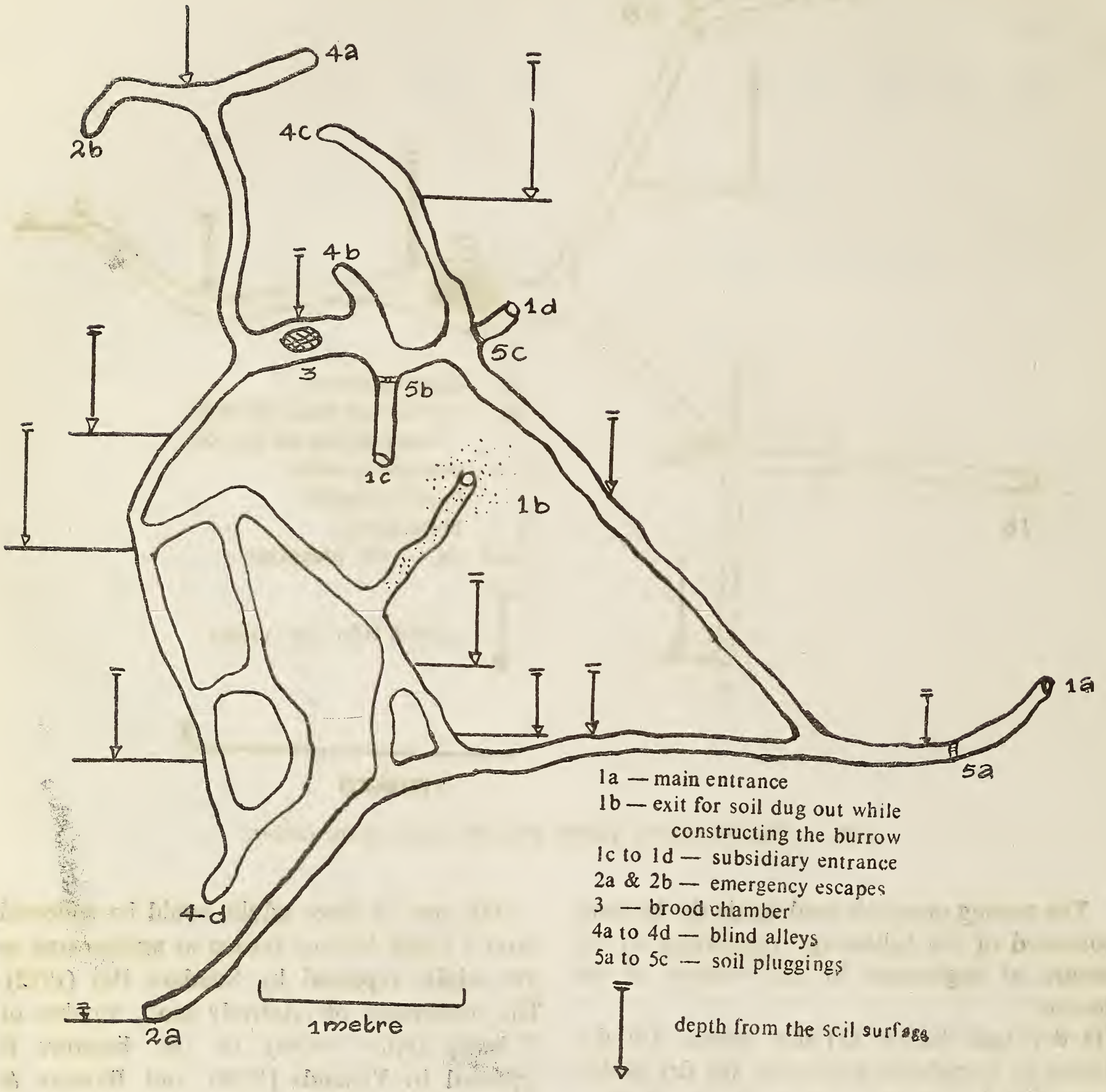
4a
2b
4c
4b
1d
5c
3
5b
1c
1b
1a
5a
4-d
2a
1metre
1a — main entrance
1b — exit for soil dug out while constructing the burrow
1c to 1d — subsidiary entrance
2a & 2b — emergency escapes
3 — brood chamber
4a to 4d — blind alleys
5a to 5c — soil pluggings
depth from the soil surface

Fig. 2. Burrow system (elongate and complex type) of *Tatera indica cuvieri.*

to indirect damage due to the burrowing activity of the rats.

The earlier reports of the food crops damaged by these rats include cereal grains in general (Yashoda 1968 ; Sundara Bai 1972) and jowar and bajra in particular (Srinivasachar 1972).

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RECENT CHANGES TO THE BURMESE MAMMAL LIST[1]

G. W. H. DAVISON[2]

The paper gives taxonomic revisions and additions to the list of Burmese mammals since the publication of the checklist by Ellerman and Morrison-Scott (1951).

INTRODUCTION

No complete list restricted solely to the mammal fauna of Burma has been published since that of Blyth (1875). The most recent list, by Ellerman & Morrison-Scott (1951) includes the mammals of the Palaearctic and the Indian subcontinent. Since 1951 there has been extremely little work on mammal collection or surveying within Burma, but numerous taxonomic changes based on material from neighbouring countries and on the older Burmese museum material are relevant to the local fauna. These changes and the few recent additions of species are compiled here for easy reference.

INSECTIVORA : SORICIDAE

The confusing history of the Pegu type specimens of the Southeast Asian White-toothed Shrew *Crocidura fuliginosa* has been described by Medway (1977). The currently accepted nomenclature of the Burmese or near-Burmese representatives of the genus is as follows :

Crocidura horsfieldi indochinensis Robinson & Kloss 1922

North Burma and the Shan States.

C. attenuata subsp. indet.

North and central Burma. Geographically it is closest to *C. a. rubricosa* Anderson 1877 from Assam and the Himalayas (Jenkins 1976), which may in fact extend into northernmost parts of Burma.

C. vorax Allen 1923

Not yet found in Burma, but the eastern Shan States are interposed between its known localities in Yunnan and at Doi Inthanon in north Thailand. This taxon is most likely to prove a subspecies of *C. russula* or *C. attenuata*, but its affinities cannot properly be decided on present evidence (P. D. Jenkins, pers. comm.).

C. fuliginosa fuliginosa (Blyth 1855)

North and central Burma south at least to Schwe Gyin in Pegu, and doubtless through Tenasserim.

C. fuliginosa dracula Thomas 1912

Northeast Burma.

PRIMATES : CERCOPITHECIDAE

Presbytis femoralis robinsoni Thomas 1910

Extreme south of Tenasserim around Maliwun. Should the Burmese specimens prove distinct from those of Peninsular Thailand, the name *keatii* Robinson & Kloss 1911 is available. I follow Wilson & Wilson (1975) in equating continental Asian banded leaf-monkeys with east Sumatran *femoralis* rather than west Sumatran *melalophos* ; previously the two were not distinguished.

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RODENTIA ; SCIURIDAE

The representatives of *Petinomys* are now known as :

Petinomys vordermanni phipsoni (Thomas 1916)

Tenasserim ; listed as a subspecies of *P. setosus* by Ellerman (1961), and apparently confused with that species by Lekagul & McNeely (1977).

P. setosus morrisi (Carter 1942)

Taro, in northern Burma ; this geographical isolate may possibly be a full species.

HYSTRICIDAE

Porcupines from Tenasserim have been listed under the name *H. hodgsoni*, the eastern Palaearctic species. On geographical grounds they are more likely to prove representative of the Sundaland *H. brachyura*. Their name would then become *H. brachyura subcristata* Swinhoe 1870. However, it is also possible that *H. hodgsoni yunnanensis* Anderson 1878 just crosses the Burma-Yunnan border.

MURIDAE

Taxonomy of the genera *Rattus* and *Mus* has been the subject of so much recent revision that the changes must be interpreted in the context of all sympatric forms. Their representatives are therefore listed in full below.

Rattus sikkimensis macmillani Hinton 1919
Hkamti, in western Upper Chindwin.

R. sikkimensis khyensis Hinton 1919

Chin Hills, Mount Popa, Maymyo and Hsipaw ; Marshall (in Lekagul & McNeely 1977) uses the name *R koratensis* Kloss 1919 for this species, on the grounds that the type specimen is inadequately labelled, but Hinton's description was published seven months before that by Kloss.

R. rattus (Linnaeus 1758)

A subspecies of *R rattus*, possibly *R. r. diardii* (Jentinck 1880), is found in Burmese cities. Rural Tenasserim rats from the mainland and islands may be referable to another species, *R. tiomanicus* (=*R. jalorensis*). Karyological distinctions between these two are clear in the south of the Malay Peninsula (Medway & Lim 1966, Yong 1969), but individual variants seem to bridge these differences in Thailand. Even so, the island subspecies are more closely related to one another than to urban *R. rattus*, and even in Thailand the urban and rural populations remain distinct with little hybridization.

R. tiomanicus robustulus (Blyth 1859)
Schwe Gyin, north Tenasserim.

R. tiomanicus tikos Hinton 1919

Tenasserim, and Malcolm, King and Sullivan Islands.

R. tiomanicus dentatus (Miller 1913)
Hastings Island.

R. tiomanicus insulanus (Miller 1913)
Helfer Island.

R. tiomanicus exsul (Miller 1913)
James Island.

R. tiomanicus fortunatus (Miller 1913)
Chance Island.

R. nitidus obsoletus Hinton 1919
Chin Hills.

R. exulans concolor (Blyth 1859)

From Bhamo in central Burma to Tenasserim.

R. norvegicus (Berkenhout 1769)

In towns, commensal with man.

R. muelleri validus (Miller 1900)
Tenasserim.

R. mackenziei mackenziei (Thomas 1916)

Chin Hills, and probably central Burma, the Shan States and north Tenasserim. Apparent sympatry with *R. bowersi* in Thailand supports its recognition at species level (Lekagul & McNeely 1977).

R. bowersi bowersi (Anderson 1879)
North Burma.

R. bowersi feae (Thomas 1916)
Muleyit.

R. manipulus manipulus (Thomas 1916)
Kindat and Kabaw valley in the Chin Hills.

R. berdmorei berdmorei (Blyth 1851)
Mergui in Tenasserim.

R. berdmorei mullulus (Thomas 1916)
Muleyit.

R. coxingi andersoni (Thomas 1911)
North Burma.

R. confucianus (Milne-Edwards 1871)

R. bukit (Bonhote 1903)

R. rapit (Bonhote 1903)

Various interbreeding fulvous and greyish rat populations in Burma and north Thailand have formerly been split between the taxa *R. niviventer* and *R. fulvescens*, names referable to damaged Nepalese material. Chasen (1940) and Marshall (in Lekagul & McNeely 1977) were forced to avoid the use of these names for lack of evidence on the affinities of the types. These authors divide the relevant populations between the three species *confucianus*, *bukit* and *rapit*, of which at least two and possibly three are represented in Burma. For their local populations Ellerman (1961) used the names *R. niviventer niviventer* (Hodgson 1836) (north Burma), *R. n. mentosus* Thomas 1916 (Upper Chindwin), and *R. fulvescens fulvescens* (Gray 1847) (Shan States to Tenasserim). At present it is impossible to assign the Burmese populations with certainty even between the three more recently recognized species, but it is thought that *R. confucianus* may be found in north Burma and the Shan States, *R. bukit* throughout eastern Burma and Tenasserim.

R. brahma (Thomas 1914)

Adung Valley in northernmost Burma. This species also lives in Assam and has been distinguished by Musser (1970) as a full species.

R. eha ninus Thomas 1922

Adung Valley and Imaw Bum, northernmost Burma.

R. cremoriventer (Miller 1900)

The following two (or three) subspecies are continental Asian members of the *cremoriventer* group with large auditory bullae. Musser (1973) treats these as distinct from Sundaland *cremoriventer* under the name *R. langbianis* with subspecies ranging from Assam to Vietnam. A compromise treatment would unite these northern Asian members within the wider ranging subspecies, *R. c. langbianis* :

R. cremoriventer indosinicus Osgood 1932
Kindat, Chin Hills.

R. cremoriventer tenaster (Thomas 1916)
Muleyit.

R. (?) cremoriventer blythi Kloss 1917

Schwe Gyin in north Tenasserim. The affinities of this taxon are uncertain, but this may prove to be a member of the southern *cremoriventer* group and the other members of the northern *langbianis* group.

R. surifer surifer (Miller 1900)

Mainland Tenasserim. Medway (1978) includes south Burma in the range of the sibling species *R. rajah* (Thomas 1894), but specimens are only known north to Trang in Peninsular Thailand (Lekagul & McNeely 1977).

R. surifer luteolus (Miller 1903)
St. Matthew Island.

R. surifer bentincanus (Miller 1903)
Bentinck Island.

R. surifer umbridorsum (Miller 1903)
Loughborough Island.

R. surifer casensis (Miller 1903)
Chance Island.

R. surifer domelicus (Miller 1903)
Domel Island. All the above five island populations are short-tailed.

R. edwardsi edwardsi (Thomas 1882)
North Burma.

R. sabanus vociferans (Miller 1900)
Tenasserim north to Mergui town.

R. sabanus matthaeus (Miller 1903)
St. Matthew Island.

R. sabanus stridulus (Miller 1903)
Bentinck Island.

R. sabanus lucas (Miller 1903)
St. Luke Island.

R. sabanus gilbiventer (Miller 1903)
Sullivan Island.

R. sabanus stentor (Miller 1913)
James Island.

R. sabanus insularum (Miller 1913)
Domel Island.

R. sabanus charae (Miller 1913)
Clara Island. The above seven island populations are referred to *sabanus* purely on grounds of external morphology.

R. kathleenae (Thomas 1914)
Pagan and Mount Popa.

Mus musculus tytleri Blyth 1859
Commensal with man in Maymyo, Pagan, Rangoon and other towns.

M. booduga lepidoides (Fry 1931)
Mount Popa.

M. cookii cookii Ryley 1914
Central and west Burma to the Indian border.

M. cervicolor popaeus (Thomas 1919)
Maymyo, Pegu and Chindwin, Mount Popa and Bhamo. By implication Marshall (in Lekagul & McNeely 1977) regards all Burmese *cervicolor* as a single taxon, and suppresses the earlier name *nitidulus* Blyth 1859 of which the identity is dubious. Ellerman (1961) grouped *cookii* and *popaeus* in the Indian *M. famulus* Bonhote 1898.

M. shortridgei (Thomas 1914)
Central Burma from Mandalay to Mount Popa and Pagan.

M. pahari pahari Thomas 1916
North Burma.

M. pahari jacksoniae (Thomas 1921)
Upper Irrawaddy drainage.

PERISSODACTYLA : RHINOCEROTIDAE

The record of *Rhinoceros unicornis* Linnaeus 1766 at Bumpha Bum in Myitkyina District in 1962 (Yin 1967) gives Burma the distinction of more rhinoceros species than any other country.

ARTIODACTYLA : BOVIDAE

The most recent mammal species to be described from Burma, *Naemorhedus cranbrooki* Hayman 1961, is found in the mountains of northernmost Burma at higher altitudes than the common goral.

ACKNOWLEDGEMENTS

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MATERIAL TO THE FLORA OF MAHABALESHWAR-3

P. V. BOLE AND M. R. ALMEIDA

[*Continued from vol.* 78(3): 567]

DROSERACEAE

Drosera Linn.

1. **Drosera indica** Linn. Sp. Pl. 282, 1753; Birdwood, 13; Cooke, T. 1 : 469 (499); Nairne, 107.

Quite common carnivorous plant among the grasses. The whole plant is glandular hairy and contains digestive enzyme, plantagin [see *Phytochemistry*, 8 (11): 2199, 1969].

Common around parking ground near Lodwick point.

FLOWERS & FRUITS : August-November.

COMMON NAME : Indian Sundew (Birdwood).

HALORAGACEAE

Myriophyllum Linn.

1. **Myriophyllum intermedium** DC., Prodr. 3:69, 1828; Birdwood, 13; Cooke, T. 1:470 (500).

M. tetrandrum Graham, Cat. Bombay Pl. 76, 1839 (non Roxb., 1820); Dalz. & Gibs., 99.

Haloragis oligantha Wight & Arn., Prodr. 338, 1834; Wight, Icon. t. 1061 (non Arn., 1836).

Common and abundant hydrophytic herb near Yenna Lake. It grows gregariously in moist grounds. It is also found in waters upto one meter depth but in that case the terminal portions always float on the surface of water.

FLOWERS & FRUITS : December-February.

COMBRETACEAE

1. Petals absent..................................2
    2. Calyx segments persistent...... *Calycopteris*
    2. Calyx segments deciduous..........*Terminalia*
1. Petals 4-5......................... *Combretum*

Calycopteris Lamk.

1. **Calycopteris floribunda** Lamk. Encycl. Menth. Suppl. 2:41, 1811; FBI 2:499; Lisboa, 213; Cooke, T. 1:481 (512); Talbot, 2:21, t. 300; Birdwood, 14; Nairne, 113.

Getonia floribunda Roxb., Cor. Pl. t. 87, 1819; Graham, 70; Dalz. & Gibs. 91.

Common climber in open forest areas and along road-sides, especially along Fitzgerald ghat and Mahad ghat. It is an attractive plant both in young flowers and in mature fruits. Young flowers are light-green in colour and mature fruits have brick-red wings.

FLOWERS : December-March;

FRUITS : March-May.

LOCAL NAMES : Baguli, Ukshi.

Combretum Linn.

1. **Combretum ovalifolium** Roxb. Fl. Ind. 256, 1832; Birdwood, 14; Cooke, T. 484 (515); Nairne, 113.

This species is included here on authority of Birdwood. Not seen or collected from this locality so far.

LOCAL NAMES : Madhyel, Shendri (Birdwood).

Terminalia Linn.

1. Fruits not winged............................2
   2. Leaves alternate, clustered at the end of the branches .... *T. bellirica*
   2. Leaves opposite, not clustered......*T. chebula*
1. Fruits 5-winged 3
   3. Veins of the wings ascending *T. arjuna*
   3. Veins of the wings horizontal *T. crenulata*

1. **Terminalia arjuna** (Roxb.) Wight & Arn. Prodr. 314, 1834 ; Dalz. & Gibs. 91 ; Lisboa, 213 ; Cooke, T. 1:479 (509) ; Birdwood, 14 ; Nairne, 112.

Pentaptera arjuna Roxb., Fl. Ind. 2:438, 1824 ; Graham, 69.

T. glabra Wight & Arn. Prodr. 314, 1834.

A rare plant at Mahabaleshwar on banks of Yenna river. The tree is very conspicuous because of its white and smooth bark.

FLOWERS : April-May ;

FRUITS : May-June.

LOCAL NAMES : Arjun, Sadhda, Kahu, Pinjal.

2. **Terminalia bellirica** (Gaertn.) Roxb., Cor. Pl. 2 : 54, t. 198, 1819 ; Wight, Ill. t. 91 ; Birdwood, 13 ; Cooke, T. 1 : 478 (508) ; Talbot, 2 : 13, t. 294 ; Nairne, 112.

Myrobalanus bellirica Gaertn. Fruct. 2 : 90, t. 97, 1791.

We have not seen this species on the plateau. It is included here on authority of Birdwood only.

FLOWERS : February-May ;

FRUITS : May-June.

LOCAL NAMES : Behda, Hela.

3. **Terminalia chebula** Retz., Obs. 5 : 31, 1798 ; Graham, 69 ; Dalz. & Gibs. 91 ; Lisboa 213 ; Cooke, T. 647 & 1 : 478 (509) ; Talbot 2 : 14, t. 295 ; Nairne, 112 ; Puri & Mahajan, 123 ; Santapau, 399, 1962.

Following two varieties of this species are found at Mahabaleshwar :

1. Leaves glabrous beneath...... ....*T. chebula* var. *chebula*
1. Leaves densely coppery pubescent beneath ....*T. chebula* var. *tomentella*

var. chebula

A common and abundant medium sized tree all over Mahabaleshwar. It is more common on table lands of Lingmala. Fruit is used in leather industry for tanning purposes, and it is one of the major item of revenue of the forest in this area.

FLOWERS : April-May ;

FRUITS : May-June.

LOCAL NAME : Hirda.

var. **tomentella** (Kurz.) C. B. Clarke, in Brit. India, 2 : 446, 1879.

Terminalia tomentella Kurz., For. Fl. Brit. Burma, 1 : 455.

This is less common variety at Lingmala found intermixed with type variety.

FLOWERS : April-May ;

FRUITS : May-June.

4. **Terminalia crenulata** Roth., Nov. Sp. 380, 1821 ; Wight & Arn., Prodr, 314, 1834.

T. tomentosa (Roxb.) Wight & Arn. Prodr. 314, 1834 (non Mart., 1841) ; Birdwood, 14 ; Nairne, 112.

Pentaptera tomentosa Roxb., Fl. Ind. 2 : 440, 1832.

T. coriacea Wight & Arn. Prodr. 315, 1834.

T. alata Roth., Nov. Sp. 379, 1821.

This species is also included here on authority of Birdwood only.

FLOWERS : April-May ;

FRUITS : May-June.

VERN. NAME : Ain.

MYRTACEAE

- 1. Leaves opposite................ 2
  - 2. Berry 1-few seeded ; calyx 4-lobed.................... *Syzigium*
  - 2. Berry many seeded ; calyx 5-lobed 3
    - 3. Fruits fleshy : trees with peeling bark .... *Psidium*
    - 3. Fruits not fleshy ; shrubs, without peeling bark.......... *Myrtus*
- 1. Leaves alternate 4
  - 4. Leaves petiolate .... *Eucalyptus*
  - 4. Leaves sessile .... *Callistemon*

Callistemon R. Br.

1. **Callistemon citrinus** (Curt.) Stapf, in Bot. Mag. 150, t. 9050 ; 1925 : K. M. Mathew, in Rec. Bot. Surv. Ind. 20 (1) : 104, 1969.

Metrocideros citrina Curtis, in Bot. Mag. 8 : t. 260, 1794.

C. lanceolatum DC., Prodr. 3 : 223, 1828 ; Bailey, L.H., Man. Cult. Pl. 725, 1958.

Cultivated in gardens for its drooping foliage and continuous blossoms.

Eucalyptus L'Herit.

1. **Eucalyptus obliquum** L'Herit., Sert. Angl. 18, t. 20, 1788 ; Birdwood, 14 ; Mathew, 113.

Australian species introduced in forest areas by forest department, on way to Panchgani.

Several other species and hybrids are also cultivated on an experimental scale at the forest nurseries near Mahabaleshwar.

FLOWERS : March-May ;

FRUITS : May-June.

Myrtus Linn.

1. **Myrtus communis** Linn. Sp. Pl. 471, 1753 ; FBI 2 : 462 ; Cooke, T. 1 : 498 (529).

Sweet scented shrub of South Europe, cultivated in gardens. Very often found along forest margins as an escape.

FLOWERS & FRUITS : Throughout the year.
LOCAL NAME : Vilayati Mendi.

Psidium Linn.

1. **Psidium guajava** Linn., Sp. Pl. 470, 1753 ; FBI 2 : 268 ; Lisboa, 214 ; Cooke, T. 1 : 498 (529) ; Nairne, 115 ; Talbot, 2 : 30 ; Santapau, 93.

P. pyriferum Linn. Sp. Pl. ed 2, 672, 1762 ; Graham, 72 ; Dalz. & Gibs. Suppl. 34.

P. pomiferum Graham, Cat. Bombay Pl. 72, 1839 ; Dalz. & Gibs. 34.

A common tree cultivated for its fruits. Quite commonly it runs wild and found naturalised along edges of forests.

FLOWERS & FRUITS : Throughout the year.
LOCAL NAME : Peru.

Syzygium Gaertner

- 1. Only cultivated plants, grafted or layered .... *S. jambosa*
- 1. Plants found growing wild from seed germination 2
  - 2. Cymes terminal or in axils of present leaves 3
    - 3. Branches 4-gonous ....*S. rubicunda*
    - 3. Branches cylindric or compressed....... .... *S. caryophyllatum*
  - 2. Cymes in axils of fallen leaves...... 4
    - 4. Large forest trees, leaves more than 5 cm. wide ...... *S. cumini*
    - 4. Riverside shrubs ; leaves less than 3 cm. wide .... *S. salicifolium*

1. **Syzygium caryophyllatum** (Linn.) Alston, in Trim. Handb. Fl. Ceylone, 6 : 116, 1931 ; Santapau, 92.

Myrtus caryophyllata Linn. Sp. Pl. 472, 1753.

Eugenia corymbosa Lamk., Encycl. 3 : 199, 1789 ; Cooke, T. 1 : 491 (522) ; Talbot, 2 : 37, t. 309.

S. caryophyllaceum Wight, Ill. 2 : 15, 1850 ; FBI 2 : 490 ; Birdwood, 14 ; Nairne, 114.

S. aromaticum (Linn.) Merrill. & Perry, in Mem. Amer. Acad. Arts & Sci. 18 : 196, 1939 ; Puri & Mahajan, 123.

Common small size tree on sides of Yenna River.

FLOWERS & FRUITS : March-July.

LOCAL NAMES : Nimbuli, Ran-lavang.

2. **Syzygium cumini** (Linn.) Skeels, in U.S. Dept. Agric. Burm. Pl. 248 : 2, 1912 ; Santapau, 398, 1962 & 302, 1963 ; Puri & Mahajan, 123.

Myrtus cumini Linn. Sp. Pl. 471, 1753.

Eugenia jambolana Lamk. Encycl. 3 : 198, 1789; FBI 2: 499; Wight, Icon. t. 535; Cooke, T. 648 & 1 : 492 (523) ; Lisboa, 213, Birdwood, 14 ; Nairne, 114.

S. jambolana DC., Prodr. 3 : 259, 1828 ; Graham, 73 ; Dalz. & Gibs. 93.

Commonest and abundant tree all over Mahabaleshwar. Fruits are edible and used for sharbats and jams.

FLOWERS : March-May ;

FRUITS : May-June.

LOCAL NAME : Jambhul.

3. **Syzygium jambos** (Linn.) Alston, in Trimen Handb. Fl. Ceylone, 6 : 15, 1931 ; Santapau, 93.

Eugenia jambos Linn. Sp. Pl. 470, 1753 ; FBI 2 : 474 ; Lisboa, 213; Cooke, T. 1 : 495 (526); Talbot 2 : 32, t. 305 ;

Jambosa vulgaris DC., Prodr. 3:286, 1828 ; Graham, 74 ; Dalz. & Gibs. Suppl. 35.

Small cultivated tree.

FLOWERS & FRUITS : February-March.

LOCAL NAME : Gulab Jamb.

4. **Syzygium rubicunda** Wight & Arn., Prodr. 330, 1834 ; Graham, 74 ; Dalz. & Gibs. 94.

Eugenia rubicunda Wight, Ill. 2 : 15, 1850 ; Wight, Icon. t. 538; FBI 2: 495; Nairne, 115.

Rare tree with small and inferior quality of fruits. Fruits are mostly eaten by animals.

FLOWERS & FRUITS : March-June.

LOCAL NAME : Lendi Jambhal.

5. **Syzygium salicifolium** Graham, Cat. Bombay Pl. 73, 1839 ; Dalz. & Gibs. 94. (non Wall. cat.)

Eugenia salicifolia Wight, Ill. 2 : 16, 1850 ; Wight, Icon. t. 539 (non DC., 1828).

E. heyneana Duthie, in Hook. f., Fl. Brit. Ind. 2: 500, 1878; Birdwood, 14; Nairne, 115.

This species is reported by Birdwood from Koyna Valley.

FLOWERS & FRUITS : May-June.

LECYTHIDACEAE

Careya Roxb.

1. **Careya arborea** Roxb. Cor. Pl. 3 : 14, t. 218, 1819 ; Graham, 74 ; Wight Ill. tt. 99-100 ; Dalz. & Gibs. 95 ; FBI 2 : 511 ; Cooke, T. 1 : 497 (528) ; Birdwood, 14 ; Nairne, 116.

A common tree in open forests. Abundant at Lingmala.

FLOWERS : March-April ;

FRUITS : April-June.

LOCAL NAME : Kumbha.

MELASTOMATACEAE

1. Seeds solitary ; trees	*Memecylon*
1. Seeds many ; annual herbs	*Sonerila*

Memecylon Linn.

1. Berries black when ripe	*M. umbellata*
1. Berries bright yellow when ripe ..	*M. talbotianum*

1. **Memecylon talbotianum** Brandis, in Talbot, Trees of Bombay, (ed. 2) in Appendix, after p. iii, 1902 ; Cooke, T. 1 : 504 (536) ; Talbot 2 : 54, t. 320 ; Puri & Mahajan, 123 ; Santapau, 96.

Mahabaleshwar is cited as one of the type locality of this species by the author. Latter authors have reported it from Mahabaleshwar on the basis of yellow coloured fruits. Rev. Fr. Santapau, in the Flora of Khandala, feels that it does not deserve even a varietal rank. After careful examination of materials available in Blatter Herbarium from Mahabaleshwar as well as from Khandala, labelled as *M. talbotianum* Brandis, we feel that true *M. talbotianum* Brandis does not occur at Mahabaleshwar and Khandala. Therefore all specimens from Mahabaleshwar identified as this species belong to *M. umbellatum* Burm. only. We have also seen and collected ripe fruiting materials of this species from North Kanara regions. We have observed that the ripe fruits of North Kanara plants have shining golden yellow colour whereas yellow colour of Mahabaleshwar fruits is found in sun-tanned unripe fruits only which turn bluish black when ripe. In herbarium specimens we have found that the dried leaves of *M. talbotianum* Brandis from N. Kanara remain yellow while leaves from materials from Mahabaleshwar turn black on drying.

2. **Memecylon umbellatum** Burm., Fl. Ind. 87, 1768 ; Cooke, T. 1 : 503 (535) ; Puri & Mahajan, 123 ; Santapau, 398, 1962 & 300, 1963.

M. edule Roxb., Pl. Cor. 1 : 59, t. 82, 1795 ; FBI 2 : 563 ; Dalz. & Gibs. 93 ; Birdwood, 14 ; Cooke, T. 646 ; Lisboa, 214 ; Talbot 2 : 53, t. 318 ; Nairne, 118.

M. tingtorium Koenig ex Wight & Arn. Prodr. 319, 1834; Wight, I11. t. 93; Graham, 71.

This is one of the commonest tree all over Mahabaleshwar.

FLOWERING : January-June.

LOCAL NAME : Anjan.

Sonerila Roxb.

1. **Sonerila scapigera** Hook., in Lond. J. Bot. 7 : 672, t. 23, 1848 ; FBI 2 : 538 ; Dalz. & Gibs. 93 ; Cooke, T. 1 : 501 (533) ; Santapau, 400, 1962 & 301, 1963 ; Nairne, 118.

Small stemless annual monsoon herb generally found near water-falls on wet rocks-face. Dorsal surface of leaf is green while ventral surface is pinkish-red or purple.

FLOWERS : July-August.

LYTHRACEAE

1. Herbs 2
    2. Flowers in axillary clusters or cymes ; capsule circumcissile or dehiscing irregularly .... *Ammania*
    2. Flowers solitary in the axil or in the terminal spikes ; capsule 4-5 valved .... *Rotala*
1. shrubs or trees.................. 3
    3. Stamens numerous........... *Lagerstroemia*
    3. Stamens definite.............. 4
    4. Stamens 8 .... *Lawsonia*
    4. Stamens 12 .... *Woodfordia*

Ammania Linn.

1. **Ammania baccifera** Linn. Sp. Pl. (ed. 2) 175, 1762 ; FBI 2 : 569 ; Dalz. & Gibs. 97 ; Cooke, T. 1 : 509 (541) ; Nairne, 120 ; Blatter & Hall. 26 : 215 ; Birdwood, 14 ; Puri & Mahajan, 123 ; Santapau, 300, 1963.

A. vesicatoria Roxb. ex Graham, Cat. Bombay Pl. 67, 1839.

A. salicifolia Hiern. in Oliv. Fl. Trop. Africa, 2 : 278, 1871 (excl. synonyms, non Monti, 1767) : FBI : 269 ; Dalz. & Gibs. 97 ; Cooke, T. 1 : 509 (541) ; Puri & Mahajan, 123.

Card Index, in Blatter Herbarium records one specimen of this species from Mahabaleshwar. But at present there is no specimen available in Blatter Herbarium.

LOCAL NAMES : Agiya, Agin buti.

Lagerstroemia Linn.

1. Petal purple, more than 2.5 cm. long ; calyx-tube ribbed .... *L. speciosa*
1. Petal white, less than 1 cm. long ; calyx-tube not ribbed 2
  2. Leaves petiolate ; calyx-tube without a ring .... *L. lanceolata*
  2. Leaves sessile or sub-sessile ; calyx-tube with a ring on inner side .... *L. parviflora*

1. **Lagerstroemia lanceolata** Wall. ex Wight & Arn., Prodr. 309, 1834 (p. p.) ; FBI 2 : 576 ; Birdwood, 14 ; Cooke, T. 1 : 513 (545).

L. microcarpa Wight, Icon. t. 109, 1840 ; Bedd., Fl. Sylvat. t. 30, 1869.

L. parviflora Dalz. & Gibs. Bombay Fl. 98, 1861. (non Roxb., 1795) ; Nairne, 120.

A medium size tree with peeling bark. Stem and bark white. A rare tree at Mahabaleshwar.

Flowers : March-May ; Fruits : May-December.

Local name : Nana.

2. **Lagerstroemia parviflora** Roxb. Pl. Cor. 1 : 47, t. 66. 1795 ; Graham, 67 ; Wight, Icon. t. 69, 1840 ; Bedd., Fl. Sylv. t. 31, 1869 ; Lisboa, 214 ; Birdwood, 14.

L. lanceolata Dalz. & Gibs. Bombay Fl. 98, 1861; (non Wall. ex Wight & Arn., 1834); Bedd., Fl. sylv. t. 32 ; 1869 ; Nairne, 121.

Common along the ghats on way to Koyna Nagar. This tree sometimes attains 10-12 m. height but scarcely reaches 30 cm in diameter at the base.

Flowers : May-August ; Fruits : June-December.

Local name : Bonderah.

3. **Lagerstroemia speciosa** (Linn.) Pers., Syn. 2 : 72, 1807 ;

Munchausia speciosa Linn. Mant. 2 : 243, 1771.

L. flos-reginae Retz., Obs. Fasc. 5 : 25, 1789 ; FBI 2 : 577 ; Cooke, T. 1 : 513 (546) ; Birdwood, 14 ; Nairne, 121.

L. reginae Roxb., Pl. Cor. 1 : 46, t. 65, 1795 ; K.N. Gandhi, Fl. Hassan Dist. 273, 1976.

Small size tree commonly cultivated in gardens.

Flowers : March-June ; Fruits : April-November.

Local name : Taman.

Lawsonia Linn.

1. **Lawsonia inermis** Linn. Sp. Pl. 349, 1753 ; Cooke, T. 1 : 511 (544).

L. alba Lamk. Encycl. Meth. Bot. 3 : 106, 1789; Graham, 67, Dalz. & Gibs. 97; FBI 2: 573 ; Nairne, 120.

Lawsonia spinosa Linn. Sp. Pl. 349, 1753 (p. p.).

Cultivated shrub commonly used as a hedge plant. Leaves are used by local ladies for decorating their hands with its red dye especially during marriage ceremony.

Flowers & Fruits : March-July.

Local name : Mendi.

Rotala Linn.

1. **Rotala floribunda** (Wight) Koehne, in Bot. Jahrb. 1 : 156, 1881 ; Gamble, Fl. Madras, 508, 1919 ; Santapau, 400, 1962.

Ameletia floribunda Wight, Ill. 206, 1840 ; Hook., Ic. Pl. t. 826, 1845; Dalz. & Gibs. 96.

Nimmonia floribunda Wight, in Madras J. Sci. 6 : 34, t. 20, 1837 ; Graham, 83.

Ammania floribunda (Wight) Clarke, in Fl. Brit. India, 2 : 567, 1897 ; Cooke, T. 650; Birdwood, 14; Cooke, T. 1: 506 (539); Nairne, 119 ; Puri & Mahajan, 123.

Very common herb on open rocky ground in wet places and along streams. 'Mahabaleshwar heather'.

Flowers & Fruits : December-January.

Woodfordia Salisb.

1. **Woodfordia fruticosa** (Linn.) Kurz., in J. Asiat. Soc. Bengal, 40 : 56, 1871 ; Santapau, 99,

Lythrum fruticosum Linn. Sp. Pl. (ed 2) 641, 1762. *W. floribunda* Salisb. Prad. London t. 42, 1806 ; FBI 2 : 572 (Excl. synonyms) ; Nairne, 120; T. Cooke, 1: 510 (543); Talbot For. Fl. 2: 58, t. 322 ; Lisboa, 214 ; Birdwood, 14 ; Puri & Mahajan, 123.

Grislea tomentosa Roxb. Pl. Cor. 1 : 29, t. 31, 1795; Graham, 67; Dalz. & Gibs. 97; Bot. Mag. t. 1906.

W. tomentosa (Roxb.) Bedd., Fl. Sylv. 117, t. 14, 1869.

Common shrub along roadsides in ghats.

FLOWERS & FRUITS : January-June.

LOCAL NAMES : Dhaiti, Dhauri.

PUNICACEAE

Punica Linn.

1. **Punica granatum** Linn., Sp. Pl. 472, 1753 ; FBI 2 : 581 ; Cooke, T. 516 (548) ; Nairne, 121.

Cultivated in gardens for flowers as an ornamental plant. Fruits are of poor quality and not eaten locally.

FLOWERING : July-December.

LOCAL NAMES : Dalimb, Anar.

ONAGRACEAE

Oenothera Linn.

1. **Oenothera rosea** Soland., in Ait., Hort. Kew, 2 : 3, 1789 ; Birdwood, 14 ; Cooke, T. 1 : 518 (552).

Small cultivated herb grown in gardens. Plant is believed to be the native of Mexico.

CARICACEAE

Carica Linn.

1. **Carica papaya** Linn., Sp. Pl. 1036, 1753 ; FBI 2 : 599 ; Graham, 80 ; Dalz. & Gibs. Suppl. 37 ; Cooke, T. 1 : 524 (557) ; Nairne, 125.

A dioecious or monoecious tree grown in gardens for its edible fruits.

FLOWERING : Throughout the year.

LOCAL NAME : Papaya.

CUCURBITACEAE

1. Petals fimbriate .... *Trichosanthes*
1. Petals not fimbriate 2
  2. Ovules erect in the fruits ...... *Dicaelospermum*
  2. Ovules horizontal in fruits 3
    3. Petal free (rarely connate at the base only) .... *Momordica*
    3. Petals united in companulate corolla 4
      4. Tendrils 2-5 branched .. 5
        5. Flowers fascicled .... *Diplocyclos*
        5. Flowers solitary ...... *Citrullus*
      4. Tendrils unbranched 6
        6. Connectives prolonged beyond anther cells.... *Cucumis*
        6. Connectives not prolonged beyond anther cells 7
          7. Flowers dioecious .. *Solena*
          7. Flowers monoecious.. 8
            8. Fruits globose .. *Zenheria*
            8. Fruits ellipsoid .. *Melothria*

Citrullus Schrad. (Nom. Cons.)

1. **Citrullus colocynthis** (Linn.) Schrad., in Linnaea 12 : 414, 1838 ; FBI 2 : 620 ; Cooke, T. 1 : 537 (571) ; Nairne, 128.

Cucumis colocynthis Linn., Sp. Pl. 1011, 1753. *Colocynthis vulgaris* Schradr. Ind. Sem. Goett. 2, 1833; Chakravarty, in Rec. Bot. Surv. India, 17 (1) : 113-4, 1959.

Rare prostrate weed trailing on grounds.

FLOWERS & FRUITS : November-January.

LOCAL NAMES : Indrayan, Kadu Kakri.

Cucumis Linn.

1. Male flowers solitary ; fruits ellipsoid-oblong or orbicular .... *C. callosus*

1. Male flowers fascicled ; fruits oblong .... *C. sativa*

1. **Cucumis callosus** (Rott.) Cogn., in Engler, Das Pflanzenr. 88 : 129, 1924 ; Santapau, 103.

Bryonia callosa Rottl., Neue Schrift. Ges. nat. Fr. Berl. 4 : 210, 1803.

C. trigonus Roxb., Fl. Ind. 2 : 219, 1824 ; FBI 2: 619; Birdwood, 14; Cooke, T. 1: 535 (569); Wight, Icon. t. 497; Wight, Ill. t. 105; Nairne, 127-8.

Common weed prostrate on ground or sometimes climbing on small bushy shrubs. Fruits bitter in taste.

FLOWERS : August-October ; FRUITS : October-June.

VERN. NAME : Karit.

2. **Cucumis sativus** Linn., Sp. Pl. 1012, 1753 ; FBI 2 : 620 ; Cooke, T. 1 : 536 (570) ; Nairne, 128.

Cultivated climbing annual grown for its edible fruits.

FLOWERING : July-September ; FRUITS : Sept.-October.

VERN. NAME : Kakdi, Khira.

Dicoelospermum Clarke

1. **Dicoelospermum ritchiei** Clarke, in Hook. f., Fl. Brit. Ind. 2 : 630, 1879 ; Cooke, T. 1 : 545 (580) ; Santapau, 400, 1962.

A rare species found only on plateau.

FLOWERS : June-October ; FRUITS : August-November.

Diplocyclos (Endl.) von Post et Kuntze.

1. **Diplocyclos palmatus** (Linn.) C. Jeffery, in Kew Bull. 15 : 352, 1962 ; Santapau & Janardanan, Check-list, Pl. Saurashtra, 25, 1965.

Bryonia palmata Linn. Sp. Pl. 1012 ; 1753 (excl. synonyms).

B. laciniosa Linn. Sp. Pl. 1013, 1753 (p.p.) ; FBI 2 : 622 ; Nairne, 129.

Bryonopsis laciniosa (Linn.) Naud. Ann. Sc. Nat. Ser. 12 : 141, 1859 (p.p., excl. type) ; Cooke, T. 1 : 534 (568).

Quite common climber among the bushes in monsoon.

FLOWERS : August-December ; FRUITS : Sept.-December.

VERN. NAMES : Shivlingi, Popti, Kandori.

Momordica Linn.

1. Flowers monoecious .... *M. charantia*

1. Flowers dioecious .... *M. dioica*

1. **Momordica charantia** Linn., Sp. Pl. 1009, 1753 ; FBI 2 : 616 ; Cooke, T. 1 : 530 (562) ; Nairne, 127 ; Chakravarty, Rec. Bot. Surv. Ind. 17 (1) : 88-9, 1959.

Cultivated climber grown for its fruits during monsoon.

FLOWERS & FRUITS : July-October.

VERN. NAMES : Karela, Kareli.

2. **Momordica dioica** Roxb. ex Willd., Sp. Pl., 4 : 605, 1805 ; FBI 2 : 617 ; Wight, Icon. tt. 505-6 ; Cooke, T. 1 : 529 (563) ; Nairne, 127 ; Santapau, 294, 1963.

Rare climber among the bushes.

FLOWERS & FRUITS : July-November.

VERN. NAME : Kartoli.

Solena Lour.

1. **Solena heterophylla** Lour., Fl. Cochinchin. 1 : 514, 1790 ; Santapau, 104-5, 1967.

Melothria heterophylla (Lour.) Cogn., in DC., Monog. Phan. 3: 618, 1881; Cooke, T. 1: 540 (574); Puri & Mahajan, 124; Santapau, 293, 1963.

Bryonia umbellata Klein., Willd. Sp. Pl. 4 : 618, 1805; Graham, 78; Dalz. & Gibs. 101. *Zehneria umbellata* Thwaites, Enum. Pl. Zeyl. 125, 1858; FBI 2: 625; Lisboa, 214 ; Birdwood, 14 ; Cooke, T. 650 ; Nairne, 129. Rare climber among the bushes.

FLOWERS & FRUITS : June-January.

VERN. NAME : Gomati.

Trichosanthes Linn.

1. **Trichosanthes tricuspidata** Lour., Fl. Cochinchin. 589, 1790 ; Jeffery, in Kew Bull. 15 : 366, 1962.

T. brachteata (Lamk.) Voight, Cat. Hort. Sub. Calcat. 58, 1845 ; Santapau, 294, 1963. *Modecca bracteata* Lamk., Encycl. 4 : 210, 1797.

T. palmata Roxb., Fl. Ind. 3 : 704, 1832 ; FBI 2: 606; Graham, 79; Wight, Ill. tt. 104-5 ; Dalz. & Gibs. 103; Cooke, T. 650 & 1: 527 (560) ; Lisboa, 214 ; Birdwood, 14 ; Nairne, 126 ; Puri & Mahajan, 123.

Quite common climber in evergreen forests. Bright-red ripe fruits are used for decorations at the time of Ganesh-chaturthi festival.

FLOWERS & FRUITS : May-August.

LOCAL NAME : Kaundal, Mukal.

Zehneria Endl.

1. **Zehneria perpusilla** (Blume) comb. nov. *Cucurbita perpusilla* Blume, Cat Hort. Buitenz. 105, 1823.

Bryonia perpusilla Blume, Bijdr. 926, 1825. *B. mysorensis* Wight & Arn., Prodr. 345, 1834; Wight, Icon. t. 758 ; Dalz. & Gibs. 101 (non Walp. 1842).

Z. mysorensis (W. & A.) Arn., in Hooker's J. Bot. 3 : 275, 1841; Jeffery, in Kew Bull. 15 : 366, 1962.

Melothria perpusilla (Bl.) Cogn., in DC. Prodr. 3 : 607, 1881 ; Cooke, T. 1 : 540 (574) ; Chakravarty, in Rec. Bull. Bot. Surv. Ind. 17 (1) : 146-8, 1959 ; Puri & Mahajan, 123 ; Santapau, 293, 1963.

Z. bauriana Clarke, in Fl. Brit. Ind. 2 : 624, 1879 (non Endl. 1833) ; Birdwood, 14 ; Cooke, T. 650 ; 1885 ; Nairne, 129.

A common climber among the bushes.

FLOWERS : June-Nov. ; FRUITS : July-Nov.

BEGONIACEAE

Begonia Linn.

1. Plants with subterranian tuber....	*B. prixophylla*
1. Plants without tuber	2
2. Fruits winged	*B. crenata*
2. Fruits not winged	*B. malabarica*

1. **Begonia crenata** Dryand, in Trans. Linn. Soc. London, 1 : 164, t. 14, 1791 ; FBI 2 : 651 ; Graham, 172 ; Dalz. & Gibs. 104 ; Birdwood, 14 ; Nairne, 131 ; Cooke, T. 650 & 1 : 549 (584) ; Puri & Mahajan, 124 ; Santapau, 400, 1963 & 290, 1963.

Common and abundant succulent herb all over in partially shaded places, in various situations, in monsoon.

FLOWERS : July-September ; FRUITS : Sept.-October.

VERN. NAMES : Berki, Motiyen.

2. **Begonia malabarica** Lamk., Encycl. 1 : 393, 1785 ; Birdwood, 14.

This species included here on authority of Birdwood. No specimens available.

3. **Begonia prixophylla** Blatter & McCann, in J. Ind. Bot. Soc. 10 (1) : 27-8, 1931.

Rare species endemic to Mahabaleshwar only. Found on the precipitous edges of Fitzgerald Ghat, on loose laterite soil. Collection can be very dangerous.

FLOWERS : August.

MOLLUGINACEAE

Glinus Linn.

1. **Glinus lotoides** Linn., Sp. Pl. 463, 1753 ; Graham, 83 ; Dalz. & Gibs. 16 & 311.

Mollugo lotoides O. Kuntze, Rev. Gen. Pl. 264, 1891.

M. hirta Thunb., Prodr. Fl. Cap. 24, 1794 ; FBI 2 : 662 ; Cooke, T. 1 : 557 (593) ; Nairne, 133 ; Birdwood, 15 ; Puri & Mahajan, 124.

Prostrate weed in rice-fields and in wastelands.

FLOWERS & FRUITS : February-April.

LOCAL NAME : Kothak.

APIACEAE

1. Umbels simple 2
2. Flowers reddish-pink .... *Centella*
2. Flowers white .... *Hydrocotyle*
1. Umbels compound 3
3. Fruits winged on margins 4
4. Fruits compressed ; Leaves pinnate or bipinnate 5
5. Petal not radiant ; wings of fruits with thin margins .. *Peucedanum*
5. Petals radiant ; wings of fruits rhickened at margins .... *Heracleum*
4. Fruits not compressed ; leaves tripinnate .... *Anethum*
3. Fruits not winged on margins 6
6. Calyx teeth distinct .... *Coriandrum*
6. Calyx teeth not distinct .... *Pimpinella*

Anethum Linn.

1. **Anethum graveolens** Linn., Sp. Pl. 263, 1753 ; Santapau & Janard. Check-list Fl. Saurashtra, 25.

Peucedanum graveolens (Linn.) Hiern., in Oliver, Fl. Trop. Africa, 3 : 19, 1871 ; FBI 2 : 709 ; Cooke, T. 1 : 570 (606) ; Nairne, 134.

A. sowa DC., Prodr. 4 : 186, 1830.

Cultivated some places for vegetables.

FLOWERS : December-February ; FRUITS : January-March.

LOCAL NAMES : Shepu, Sowa.

Centella Linn.

1. **Centella asiatica** (Linn.) Urban, in Mant. Fl. Brasil. 11 : 287, 1879 ; Santapau, 309, 1963 ; Puri & Mahajan, 124.

Hydrocotyle asiatica Linn., Sp. Pl. 234, 1753 ; FBI 2 : 669 ; Wight, Icon. t. 565 ; Cooke, T. 650 & 1 : 562 (598) ; Lisboa, 214 ; Birdwood, 15 ; Nairne, 135.

Common creeping herb on moist grounds and on sides of rice -fields.

FLOWERS : Throughout the year.

LOCAL NAMES : Kariuna, Bhamni, Brahmi.

Coriandrum Linn.

1. **Coriandrum sativum** Linn., Sp. Pl. 258, 1753 ; FBI 2 : 717 ; Cooke, T. 1 : 573 (609) ; Nairne, 134.

Cultivated. Whole plant as well as seeds are used as condiment.

FLOWERS & FRUITS : Throughout the year.

LOCAL NAMES : Kothmir, Dhana.

Heracleum Linn.

1. Bracteoles 5 ; commissure 6-vittate .... *H. concanense*
1. Bracteoles 3 ; commissure 2-vittate .... *H. pinda*

1. **Heracleum concanense** Dalz., in Hook. J. Bot. 2 : 26, 1850 ; FBI 2 : 716 ; Dalz. & Gibs. 107 ; Birdwood, 15 ; Cooke, T. 650 & 1 : 571 (608) ; Nairne, 136 ; Puri & Mahajan, 124 ; Santapau, 400, 1962 & 310, 1963.

H. grandiflorum Dalz., Bombay Fl. 108, 1861.

Quite common herb among the grasses at Wilson Point and Lingmala.

FLOWERS : August-Sept. ; FRUITS : Sept.-Oct.

2. **Heracleum pinda** Dalz. & Gibs., Bombay Fl. 107, 1861 ; Nairne, 136.

This species reported from Mahabaleshwar by Nairne. Nairne mentions Dr. T. Cooke's authority for this record, but Cooke, in Fl. Presidency of Bombay, includes it on authority of Dalzell & Gibson.

FLOWERS : July-August.

LOCAL NAME : Pinda.

Hydrocotyle Linn.

1. **Hydrocotyle sibthorpioides** Lamk., Encycl. 3 : 153, 1789 ; K. N. Gandhi, in Fl. Hassan Dist. 417, 1976.

H. rotundifolia Roxb. ex DC., Prodr. 4 : 64, 1830 ; Wight, Icon. t. 564 ; Birdwood, 15.

This species included here on authority of Birdwood.

FLOWERS : March.

Peucedanum Linn.

1. **Peucedanum grande** (Dalz. & Gibs.) Clarke, in Fl. Brit. Ind. 2 : 710, 1879 ; Birdwood, 15 ; Cooke, T. 1 : 569 (605) ; Nairne, 135 ; Santapau, 310, 1963.

Pastinaca grandis Dalz. & Gibs. Bombay Fl. 107, 1861.

Common succulent herb during monsoon on faces of rocks. Occasionally found among the grasses also. Often used as condiment.

FLOWERS & FRUITS : July-September.

LOCAL NAME : Baphali.

Pimpinella Linn.

1. Flowers hermophrodite 2
  2. Bracts absent .... *P. tomentosa*
  2. Bracts 3-7 .... *P. adscendens*
1. Flowers monoecious .... *P. wallichiana*

1. **Pimpinella adscendens** Dalz., in Hook. J. Bot. 2 : 261, 1850 ; Dalz. & Gibs. 106 ; FBI 2 : 689 : Nairne, 135 : Cooke, T. 1 : 567 (603) ; Santapau, 110, 1967.

Ascending annual herb with radical leaves. Quite common in open grasslands.

FLOWERS : November-May.

2. **Pimpinella tomentosa** Dalz. ex Clarke, in Hook. f. Fl. Brit. India, 2 : 689, 1789 ; Woodrow, in J. Bombay nat. Hist. Soc. 11 : 643, 1898 ; Cooke, T. 1 : 566 (602) ; Birdwood, 15 : Puri & Mahajan, 124.

A rare herb along road-sides in ghat areas.

FLOWERS & FRUITS : October-November.

3. **Pimpinella wallichiana** (Miq.) K. N. Gandhi, in Fl. Hassan Dist. 417, 1976.

Helosciadium wallichianum Miq., Bot. Zeit 7 : 775, 1849.

P. monoica Dalz., in Kew J. Bot. 3 : 212, 1851 ; FBI 2 : 687 ; Dalz. & Gibs. 106 ; Nairne, 135 ; Cooke, T. 1 : 566 (603) ; Birdwood, 15 ; Puri & Mahajan, 124 ; Santapau, 401 ; 1962 & 310, 1963.

A rare herb along road-sides and along borders of forests. Common on Bombay point.

FLOWERS : August-January.

LOCAL NAME : Bhalga.

RUBIACEAE

1. Trees or shrubs 2
  2. Ovules more than 2, usually many in each cell 3
    3. Flowers in globose heads .. 4
      4. Corolla lobes imbricate ; flowers ebracteolate...... *Anthocephalus*
      4. Corolla lobes valvate ; flowers bracteolate 3
      5. Peduncles axillary, 1-3 together ; calyx lobed ; stigma clavate ; capsule cuneate, not ribbed.............. *Adina*
      5. Peduncles terminal, solitary ; calyx truncate, not lobed ; stigma mitriform ; capsule oblong, faintly 10-ribbed ...... *Mitragyna*

3. Flowers not in globose heads	6
6. Fruit a capsule	7
7. Corolla imbricate or contorted ; seeds not winged	*Wendlandia*
7. Corolla valvate ; seeds winged	8
8. Panicles with foliaceous bracts ; corolla lobes glabrous	*Hymenodictyon*
8. Panicles without foliaceous bracts ; corolla lobes pilose on the margins	*Cinchona*
6. Fruit a berry or drupe ..	9
9. Flowers axillary, solitary	*Xeromphis*
9. Flowers axillary or terminal corymbose cymes	*Randia*
2. Ovules one in each cell	10
10. Corolla lobes contorted	11
11. Calyculus present ..	*Coffea*
11. Calyculus absent ..	12
12. Stipules inter-petiolar	*Ixora*
12. Stipules intra-petiolar	*Pavetta*
10. Corolla lobes valvate ..	13
13. Ovary 2-celled	14
14. Inflorescence axillary	*Canthium*
14. Inflorescence terminal	*Psychotria*
13. Ovary more than 2-celled	15
15. Fruit a capsule..	*Spermadyctyon*
15. Fruit a drupe ..	16
16. Plants armed	*Meyna*
16. Plants unarmed	*Lesianthus*
1. Herbs or undershrubs	17
17. Climbing herbs ; stipules leafy..................	*Rubia*
17. Non-climbing plants ; stipules not leafy	18
18. Seeds angular, Globose or ellipsoid	*Oldenlandia*
18. Seeds boat-shaped or plano-convex	*Neanotis*

Adina Salisb.

1. **Adina cordifolia** (Roxb.) Benth. & Hooke. f. ex Brandis, Forest Fl. 263, t. 33, 1874 ; Birdwood 15 ; Cooke, T. 1 : 581 (2 : 7) ; Nairne, 142.

Nauclea cordifolia Roxb., Pl. Cor. 1 : 40, t. 53, 1796.

This species given here on authority of Birdwood only.

LOCAL NAMES : Haldu, Hed.

Anthocephalus A. Rich.

1. **Anthocephalus cadamba** (Roxb.) Miq., Fl. Ind. Bat. 2 : 135, 1856 ; FBI 3 : 23, 1880 ; Lisboa, 215 ; Birdwood, 15 ; Nairne, 141 ; Blatter & McCann, 36 (4) : 781, 1933.

Nauclea cadamba Roxb. Fl. Ind. 1 : 512, 1820 ; Bedd., Fl. Sylv. 35 ; Graham, 87 ; Dalz. & Gibs. suppl. 43.

A. indicus A Rich., in Mem. Soc. Hist. Nat. Paris 5 : 238, 1834 ; Cooke, T. 1 : 579 (2 : 6).

This tree is only found near Wada, below Mahabaleshwar. It is not reported from Mahabaleshwar Plateau.

FLOWERS : September-February.

LOCAL NAMES : Nhiv, Kadamb, Kalam.

Canthium Lamk.

1. Unarmed trees..................	*C. dicoccum* var. *umbellatum*
1. Spinous shrubs	*C. angustifolium*

1. **Canthium angustifolium** Roxb., Fl. Ind. 2 169, 1824 ; Birdwood, 15, FBI 3 : 135, 1880 ; Nairne, 145.

Dondisia leshenaulti DC., Prodr. 4 : 469, 1830.

C. leshenaulti (DC.) Wight & Arn., Prodr. 426, 1834 ; Wight, Icon. t. 826 ; Blatter & McCann, 36 : 790.

Plectronia rheedei Bedd., For. Man. in Fl. Sylvat. 134, 1874 ; Cooke, t. 1 : 606 (2 : 35-6).

C. rheedei DC., Prodr. 4 : 474, 1830 ; FBI 3 : 134 ; Graham, 91 ; Dalz. & Gibs. 113.

This species is included here on authority of Birdwood.

LOCAL NAME : Chap Yel.

2. **Canthium dicoccum** (Gaertn.) Teys. & Binn. var. **umbellatum** (Gamble) Sant. & Merchant, Bull. Bot. Surv. Ind. 3 : 107, 1962 ; Santapau, 117.

C. umbellatum Wight, Icon. t. 1034, 1845 (non Korth, 1851) Nairne, 145 ; FBI 3 : 132.

C. didymum auct. (non Gaertn., 1807) ; Beddome, Fl. Sylvat. t. 221, 1872 ; Graham, 91 ; Birdwood, 16 ; Blatter & McCann, 36 : 790.

Plectronia didyma (Gaertn.) Kurz., var. *umbellata* (Wight) Gamble, Fl. Madras, 624, 1921.

C. dicoccum auct. (non Gaertn.) Teys & Binn. ; Puri & Mahajan, Bull. Bot. Surv. Ind. 2 : 124, 1960 ; Santapau, 399, 1962 & 306, 1963.

P. wightii T. Cooke, Fl. Presd. Bombay, 1 : 606, 1903.

Handsome unarmed evergreen tree. Very common in forest areas.

FLOWERS & FRUITS : February-May.

LOCAL NAMES : Tupa, Arsul.

Cinchona Linn.

1. **Cinchona succirubra** Pav., ex Klotzsch, in Abh. Acad. Berl. 1957 : 60, 1958.

This species was cultivated at Mahabaleshwar for its bark, but the project did not succeed. Besides this species *Cinchona cordifolia* Mutis and *Cinchona condaminia* Humbolt. & Bonapl. have been reported by Dr. J. C. Lisboa (p. 215), to have been planted at Lingmala and Carvalho's Garden, which were having stunted growth. Now these species are not found at Mahabaleshwar.

Coffea Linn.

1. **Coffea arabica** Linn., Sp. Pl. 172, 1753 ; Birdwood, 15 ; Nairne, 148 ; Cooke, T. 1 : 626 (2 : 55).

Few plants are cultivated between Mahabaleshwar and Panchgani, in gardens.

FLOWERS & FRUITS : January-April.

LOCAL NAME : Coffee.

Hymenodictyon Wall. (nom. cons.)

1. **Hymenodictyon excelsum** (Roxb.) Wall., in Roxb. Fl. Ind. 2 : 149, 1824 ; Birdwood, 15.

Cinchona excelsa Roxb., Pl. Cor. 2 : t. 106, 1798.

This species included here on authority of Birdwood only.

Ixora Linn.

1. Trees........................	*I. arborea*
1. Shrubs	*I. nigricans*

1. **Ixora arborea** Roxb. ex J. E. Smith, in Rees, Cyclop. 19 : 5, 1811 ; Santapau, 119.

I. parviflora Vahl, Symb. 3 : 11, t. 52, 1794 (non Lamk. 1791); Wight, Icon. t. 711, 1843 ; Cooke, T. 1 : 611 (2 : 39) ; FBI 3 : 142 ; Markham, 386, 1880.

This species included here on authority of Markham.

2. **Ixora nigricans** R. Br. ex Wight & Arn., Prodr. 428, 1824 ; Dalz. & Gibs. 113 ; Wight,

Icon. t. 318, 1840; Nairne, 146; Cooke, T. 1 : 609 (2 : 38); Puri & Mahajan, 124.

I. affinis Wall. ex Blatter & McCann, in J. Bombay nat. Hist. Soc. 36 : 791.

A rare shrub in forest area.

FLOWERS & FRUITS : May-December.

Lasianthus Jack. (nom. cons.)

1. **Lasianthus venulosus** (Wight & Arn.) Wight, in Calcutta J. nat. Hist. 6 : 508, 1845; Wight, Icon. t. 1032, 1845; Beddome, Fl. Sylvat. 134, t. 17, f. 5, 1869.

Santia venulosa Wight & Arn., Prodr. 422, 1834; Markham, 386; Dalz. & Gibs. 114.

This species reported here on authority of Markham (1880).

Mitrgyna Korthals (Nom-Cons.)

1. **Mitrgyna parvifolia** (Roxb.) Kort., Obs. Naucl. Ind. 19, 1839; Cooke, T. 1 : 581 (2 : 8); Blatter & McCann, 36 : 782, 1933.

Nauclea parvifolia Roxb., Pl. Cor. 1 : 40, t. 52, 1795; Graham, 87.

N. parviflora Dalz. & Gibs., Bombay Fl. 118, 1861.

Stephegyne parvifolia Korth., Verh. nat. Ges. Bot. 161, 1840; FBI 3 : 25; Talbot 2 : 86-7, t. 335; Birdwood, 15; Nairne, 142.

This species is reported here on authority of Birdwood.

VERN. NAMES : Kalam, Niv.

Meyna Roxb.

1. **Meyna laxiflora** Robyns, Bull. Jard. Bot. Etat. Bruxells 11 : 228, 1928; Santapau, 118.

Vangueria spinosa Roxb., Fl. Ind. 2 : 172, 1824; Graham, 90; FBI 3 : 136; Nairne, 145; Cooke, T. 1 : 607 (2 : 36); Birdwood, 16; (omnes p.p.); Puri & Mahajan, 124.

Rare small size tree along forest margins. Fruits which turn brownish-black after ripening are eaten by local people.

FLOWERS : December-May; FRUITS : December-July.

LOCAL NAMES : Alu, Halu.

Neanotis Lewis

1. Cymes corymbose 2
    2. Capsule globose.............. *N. rheedii*
    2. Capsule broader than long, not globose 3
        3. Calyx teeth large, deflexed in fruits; fruits 6-seeded .... *N. lancifolia*
        3. Calyx teeth small; fruits 20-40 seeded .... *N. calycina*
1. Cymes clustered .... *N. foetida*

1. **Neanotis calycina** (Wall. ex Hook. f.) W.H. Lewis, Annales Missouri Bot. Gard. 53 : 37, 1966.

Anotis calycina Wall. ex Hook. f., in Fl. Brit. India, 3 : 73, 1880.

Common and abundant herb among the grasses and on embankments. Very common at Wilson point, Kate's point, Tiger path, Fitzgerald ghat, near Yenna lake and bus stand.

FLOWERS & FRUITS : August-November.

2. **Neanotis foetida** (Dalz.) W.H. Lewis, Ann. Miss. Bot. Gard. 53 : 38, 1966.

Hedyotis foetida Dalzell, Hook. J. Bot. Kew, Gard. Misc. 2 : 134, 1850; Dalz. & Gibs. 116.

Anotis foetida (Dalz.) Hook. f., in Fl. Brit. Ind. 3 : 74, 1880; Cooke, T. 1 : 595 (2 : 22); Blatter & McCann, 36 : 786.

Common herb on grassy exposed grounds and on laterite flats at Wilson point and Kate's point.

FLOWERS & FRUITS : August-November.

3. **Neanotis lancifolia** (Hook. f.) W. H. Lewis, in Ann. Miss. Bot. Gard. 53 : 39, 1966.

Hedyotis lancifolia Dalz., in Hook. J. Bot. Kew. Gard. Misc. 2 : 135, 1850 (non Schum., 1827).

Anotis lancifolia Bentham & Hooker, in Gen. Pl. 2 : 59, 1873 ; FBI 3 : 73 ; Cooke, T. 1 : 593 (2 : 20) ; Blatter & McCann, 36 : 786.

Very common and abundant herb on walls and embankments. Less common in forest areas. Found at Chinaman's falls, Wilson point, Lingmala, Petit Road, Fitzgerald ghat, Arther's seat, sides of Yenna lake etc.

FLOWERS & FRUITS : August-December.

4. **Neanotis rheedei** (Wt. & Arn.) W. H. Lewis, Ann. Miss. Bot. Gard. 53 : 40, 1966.

Hedyotis rheedei Wight & Arn., Prodr. 409, 1834.

H. latifolia Dalz., in Hook. J. Bot. Kew Misc. 2 : 133, 1850 ; Dalz. & Gibs. 116.

Anotis rheedei Benth. & Hook. f., in Gen. Pl. 2 : 59, 1873 ; FBI 3 : 73 ; Cooke, T. 1 : 593 (2 : 21) ; Blatter & McCann, 36 : 786.

This species is collected from Wada, below Mahabaleshwar plateau. There is no reliable specimen from the hill proper.

Oldenlandia Linn.

1. Calyx lobes pubescent, with intermediate teeth between calyx lobes . . *O. maheshwarii*
1. Calyx lobes glabrous, without intermediate teeth 2
    2. Top of capsule flat, not protruding . . . . *O. corymbosa*
    2. Top of capsule rounded, protruding . . . . *O. herbacea*

1. **Oldenlandia corymbosa** Linn., Sp. Pl. 119, 1753 ; FBI 3 : 64 ; Nairne, 143 ; Cooke, T. 650 & 1 : 588 (2 : 15) ; Blatter & McCann, 36 : 784 ; Birdwood, 15 ; Puri & Mahajan, 124.

Hedyotis burmanniana Br., in Graham, Cat. Bombay Pl. 90, 1839 ; Dalz. & Gibs., 116.

A common weed in rice-fields and in wet places.

FLOWERS & FRUITS : July-November.

LOCAL NAME : Pitpapda.

2. **Oldenlandia herbacea** (Linn.) Roxb., Fl. Ind. 1 : 424, 1820 ; Cooke, T. 1 : 589 (2 : 16) ; Blatter & McCann, 36 : 784.

Hedyotis herbacea Linn., Sp. Pl. 102, 1753.

H. heynii R. Br., in Dalz. & Gibs., Bombay Fl. 116, 1861.

O. heynii G. Don, Gen. Syst. 3 : 531, 1834 ; Graham, 90 ; FBI 3 : 65 ; Nairne, 143.

Common erect herb among the grasses. It is found abundantly in drying rice-fields after the harvests.

FLOWERS & FRUITS : August-November.

LOCAL NAME : Paripath.

3. **Oldenlandia maheshwarii** Santapau & Merchant, in J. Ind. Bot. Soc. 42A : 213-5, ff. 1-6, 1964 ; Santapau, 115-6.

Quite common herb among the grasses.

FLOWERS & FRUITS : September-November.

Pavetta Linn.

1. Leaves tomentose beneath . . . . *P. tomentosa*
1. Leaves glabrous . . . . *P. crassicaulis*

1. **Pavetta crassicaulis** Bremek., Fedde, Repert. 37 : 112, 1934 & 47 : 25, 1939 ; Ker & Panigrahi, Bull. Bot. Surv. Ind. 5 : 234, 1963 ; Santapau, 120.

P. indica auct. plur. (non Linn., 1753) ; Graham, Ct. Bombay Pl. 92, 1839 ; Dalz. & Gibs. 112 ; Cooke, T. 649 & 1 : 612 (2 : 41) ; FBI 3 : 150 ; Lisboa, 215 ; Nairne, 146 ; Santapau, 399, 1962 & 306, 1963 ; Puri & Mahajan, 124.

P. indica Linn. var. *glabra* Blatter & Hallberg, in J. Bombay nat. Hist. Soc. 36 : 792, 1933.

Common and abundant plant on sloping grounds. Very common at Lingmala, Chinaman's Falls, Wilson point, Fitzgerald ghat, Petit Road, Yenna lake banks and on way to Wada.

FLOWERS & FRUITS : Throughout the year.

LOCAL NAMES : Papat, Papti.

2. **Pavetta tomentosa** Roxb., ex Rees, Cyclop. 26 : 2, 1819 ; Wight & Arn., Prodr. 431, 1832 ; Santapau, 120.

P. brunonis Wight, Icon. t. 1065, 1845 ; Dalz. & Gibs. 112.

Ixora tomentosa Roxb., Fl. Ind. 1 : 386, 1832 ; Wight, Icon. t. 186.

P. indica Linn. var. *tomentosa* Hook. f., in Fl. Brit. Ind. 3 : 150, 1880 ; Cooke, T. 1 : 613 (2 : 41) ; Blatter & McCann, 36 : 792.

P. hispidula sensu Birdwood, 16, 1897 (non Wight & Arn., 1834).

Common all over Mahabaleshwar, especially along the edges of the forests at Lingmala and Chinaman's falls.

FLOWERS : March-June ; FRUITS : June-December.

Psychotria Linn. (nom. cons.)

1. **Psychotria truncata** Wall., in Roxb. Fl. Ind. (Carey ed.) 2 : 162, 1824 ; Nairne, 148 ; Cooke, T. 649 & 1 : 616 (2 : 44) ; Birdwood, 16 ; Santapau, 399, 1962 & 306, 1963 ; Puri & Mahajan, 124.

Grumilea congesta Graham, Cat. Bombay Pl. 92, 1839 (non Wight & Arn., 1834).

G. vaginans Dalz. & Gibs., Bombay Fl. 111, 1861.

P. vaginan Wight & Arn., Prodr. 434, 1834 ; Lisboa, 215.

A common undershrub in shady places among the undergrowths near Chinaman's falls.

FLOWERS & FRUITS : February-June.

Randia Linn.

1. **Randia rugulosa** (Thwaites) Hook. f., in Fl. Brit. Ind. 3 : 113, 1880 ; Talbot, 189 ; Birdwood, 16 ; Cooke, T. 1 : 600 (2 : 28).

Griffithia rugulosa Thwaites, Enum. Pl. Ceyl. 159, 1859.

G. speciosa Bedd., Icon. Pl. Ind. Or. t. 37, 1874.

Rare climbing shrub in densely shaded forests along Lingmala and Tiger path.

FLOWERS & FRUITS : December-July.

Rubia Linn.

1. **Rubia cordifolia** Linn., Mant. Pl. 197, 1767 ; FBI 3 : 202 ; Graham, 93 ; Dalz. & Gibs. 121 ; Wight, Ill. t. 128, f. 1 (bis) ; Cooke, T. 650 & 1 : 625 (2 : 54-5) ; Nairne, 148 ; Birdwood, 16 ; Lisboa, 215 ; Santapau, 307, 1963 ; Puri & Mahajan, 124.

R. mangista Roxb., Fl. Ind. 1 : 384, 1820 ; Wight, Icon. t. 187, 1839.

Quite common climber all over among the bushes.

FLOWERS & FRUITS : August-January.

LOCAL NAMES : Manjit, Itari, Itta, Manjishtha.

Spermadictyon Roxb.

1. **Spermadictyon suaveolens** Roxb., Pl. Cor. 3 : 32, t. 236, 1815 ; Santapau, 120 ; Santapau & Merchant, Bull. Bot. Surv. Ind. 3 : 110, 1961.

Hamiltonia suaveolens Roxb., Fl. Ind. 2 : 223, 1824 ; FBI 3 : 197 ; Cooke, T. 1 : 621 (2 : 51) ; Birdwood, 16 ; Nairne, 147 ; Talbot 2 : 134, t. 364, 1918 ; Blatter & McCann, 36 : 794.

H. mysorensis Wight & Arn., Prodr. 423, 1834 ; Graham, 91 ; Dalz. & Gibs., 115.

Rare species usually found on steep hill-slopes growing in dangerous rock-crevices.

Flowers & Fruits : December-April.

Local name : Gersao.

Wendlandia Bart.

1. **Wendlandia thyrsoides** (Roem. & Schultz) Steud., Nom. ed. 2, 2 : 786, 1841 ; Blatter & McCann, 36 : 782 ; Santapau, 307, 1963.

Canthium thyrsoideum Roem. & Schultez, Syst. 6 : 207, 1820.

W. notoniana Wall. ex Graham, Cat. Bombay Pl. 89, 1839 ; Dalz. & Gibs. 117 ; Wight, Icon. t. 1033, 1845 ; Talbot 2 : 92, t. 338 ; Nairne, 142 ; Cooke, T. 649 & 1 : 584 (2 : 11) ; Beddome, Fl. Sylv. t. 224, 1872 ; Birdwood, 15 ; Puri & Mahajan, 124.

A common and abundant small size tree along sides of Yenna River and near Lingmala falls.

Flowers & Fruits : December-May.

Xeromphis Rafin.

1. **Xeromphis spinosa** (Thunb.) Keay, Bull. Jard. Bot. Etat. Bruxsells, 28 : 37, 1858 ; Maheshwari, in Bull. Bot. Surv. Ind. 3 (1) : 91, 1961.

Gardenia spinosa Thunb., Diss. Gard. no. 7, 1780.

Randia brandisii Gamble, Fl. Madras, 616, 1921 ; Blatter & McCann, 36 : 787 ; Puri & Mahajan, 124 ; Santapau, 398, 1962 & 306, 1963.

G. tomentosa Retz., Obs. 2 : 14, 1781.

R. dumetorum Lamk., Encycl. suppl. 2 : 829, 1811 ; Graham, 89 ; Dalz. & Gibs. 119 ; Wight, Icon. t. 580 ; FBI 3 : 110 ; Nairne, 144; Cooke, T. 649 & 1 : 599 (2 : 27) ; Lisboa, 215 ; Talbot 2 : 98, t. 341.

One of the commonest trees of Mahabaleshwar. Fruits are used by local people for fish-killing.

Flowers & Fruits : March-June.

Local names : Gela, Mindhal.

(*to be continued*)

SOME ASPECTS OF THE REPRODUCTIVE BIOLOGY OF THE LION-TAIL MACAQUE—*MACACA SILENUS* (LINN.)—A ZOO STUDY[1]

L. S. RAMASWAMI[2], G. U. KURUP[3], AND B. A. GADGIL[4]

The reproductive biology of the lion-tail monkey at the Children's Park Zoo, Madras and at the Zoos at Bombay and at Kolhapur was studied. Two successive pregnancies of the same female were checked in our Madras study. The pregnant female did not show an enlarged belly; palpation was not possible; the female occasionally squeezed out milk from the nipples. A male baby was born (20th March 1976) which died after 4 months and 10 days, probably due to insufficiency of mother's milk. A second male baby was born of the same female on 6th March 1977, sired by the same male. This baby grew up well; the mother died on 8th March. The coat colour of the babies was black but they had no mane at birth. When the second baby was examined 7 months later, a mane had grown. The probable period of pregnancy is 180-187 days. The sex skin cycle in this female was not followed. At the Bombay Zoo garden, two female lion-tails showed menstrual cycle with a mode at 39 days; the menses (both overt and occult) lasted for 2-2.5 days. A summer amenorrhea was noticed. The sex skin tumescence started from day 6/7 of the cycle and reached a maximum on day 10. The subcaudal, perianal and paravulval (enclosing the callosities) tumescences were prominent. Detumescence was noticed from days 22-27 of the cycle. Probably ovulation takes place around 21/22 days of the cycle when the sex skin starts wrinkling. Vaginal cytology showed the presence of cornified or superficial cells at this time. Copulations generally took place at this time. On 24th July 1979, a male baby was born and when Ramaswami examined this lively baby on 30th March 1981, he was 1 year, 8 months and 10 days old. At the Kolhapur Zoo garden, a female lion-tail gave birth to a male baby years ago (which is continuing to live) and there were no further conceptions and one of the reasons for this may be that the female lived in constant dread of the vicious male in the same cage.

INTRODUCTION

The lion-tail macaque is restricted to the southern part of the Western ghats of India from Jog Falls to Agasthya Ranges (Kurup 1977). From south of Bramhagiri ranges in Coorg, the Nilgiri langur *Presbytis johnii* also with a similar coat colour, is a congener with the lion-tail monkey. The latter is readily distinguished by its grey facial mane and short tufted tail. Both were considered to be endangered species but while the Nilgiri langur shows an upward trend, the lion-tail is still very much endangered. Two recent estimates of the lion-tail put the total population as 405 by Green and Minkowasky (1977) and 800 by Kurup (1977).

OBSERVATIONS AND DISCUSSION

At the Children's Park Zoo, Guindy, Madras (India), they have a pair of lion-tail monkeys; the male was procured from the wild on 28th April 1970. An adult female, which was a pet with a family, was donated to the Zoo on 25th March 1975 and she was housed with the male. She was probably cycling regularly. The Forest Officer in charge of the Park Zoo told us of the characteristic sex skin in the

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posterior region of the female waxing and waning.

Kurup and Ramaswami examined the above female at the Park Zoo on 23rd January 1976. The sexual swelling had completely detumesced but the vulval area was red in colour. The vaginal temperature was 101.6°F. A vaginal smear was taken with great difficulty but it did not disclose any cornified cells. No external manifestation of pregnancy was apparent and rectal palpation was not possible as she was too sensitive to handling. However, a male baby was born on 20th March 1976. When we examined the female very clearly on 23rd January 1976, she was pregnant, 56 days prior to parturition. Assuming that the period of gestation was 187+? days in this, as it was in the second pregnancy which we also studied, she must have conceived by about the middle of September 1975. From the time of admission (25th March 1975) to the middle of September 1975, we are not sure of the cycles she may have passed through keeping in mind the summer amenorrhea in these macaques and that each cycle lasts around 39 days in the lion-tail monkey.

From the date of admission to the Park Zoo to the end of September 1975, no record of the reproductive life of this female was maintained. When the female delivered a baby, the adult male was moved into another cage.

The baby had a blackish coat with no mane. It was 4 months and 10 days when it died (1st August 1976). The Park Zoo authorities felt that the death was due to insufficiency of mother's milk but hand-rearing was not resorted to as it was found difficult to separate the suckling baby from the mother. Birth of lion-tail macaques from an Indian Zoo (Delhi) has been reported by Sankhala and Desai (1969).

The Park Zoo authorities let the male and female lion-tails together again during the second week of September, 1976. Monkeys which go generally into summer amenorrhea, return to cycle by about the middle of August. The male was noticed to mount the female a number of times and he was then separated. Kurup and Ramaswami examined this female on 15th November 1976. The sex skin including the subcaudal one had completely detumesced and the vulval area was red in colour as on the previous examination. If the female had been impregnated during her stay with the male, she must be pregnant again, 3 months and 15 days after the death of the first baby. As before, palpation of the abdomen did not help. It is difficult to say when the female lion-tail started cycling but according to information from the Park Zoo authorities, she became receptive only after the death of the first baby (1st August, 1976). No record of the tumescence of the sex skin, after the death of the baby and after she renewed her cycles, had been maintained.

On 4th February 1977, Kurup and Ramaswami again examined the same lion-tail female at the Park Zoo, Guindy, Madras. The detumesced condition of the sex skin continued but the ischial callosities were hard. The whole vulval region was red in colour and sensitive to handling. The vaginal temperature was 101.0°F., and the smear did not disclose any superficial cells. Abdominal palpation was not helpful and she did not permit a rectal one. The breasts were enlarged and she occasionally squeezed out milk from the pink teats. This is not unusual in pregnant monkeys. Speert (1948) proved that in the pregnant rhesus monkey, by the end of the 4th month, secretory activity in the mammary glands was well established ; this continued to increase up to term (165 days). In the human female, according to Jeffcoate (1967), ' milk is never produced until the placenta is delivered or ceases to function '. Monkeys seem to differ from the human species in this.

A male baby (christened Reuben) was born of this female on the afternoon of 6th March 1977 which both Kurup and Ramaswami examined on 29th March 1977. His coat was completely black with no mane confirming our observation on the previous occasion. His face, hands and feet were pinkish. Unfortunately the mother died on 8th March 1977. The baby was being bottle-fed and he sucked his right thumb incessantly. This is also noticed in human babies which are weaned prematurely. We examined Reuben almost 7 months later, on 5th October. He had grown up and had developed a grey mane. He ran about freely and had become a loved pet. He had started eating solid food including tender shoots and had abandoned his thumb-sucking habit. According to Green and Minkowaski (op. cit.), the lion-tail female may not give birth to more than 2-3 babies in her life-time since the adults are not long-lived.

According to Sugiyama (1968), the new-born lion-tail baby has brown hair and pale pink skin. One month later, the skin colour changes to a pale brown or grey.

Assuming that impregnation took place in the first week of September 1976 in the lion-tail examined by us (after which the female was separated from her mate) the gestation period works out to 180-187 days. This is not very much out of the mark as Macdonald (1971) reported a maximum of 190 days in *M. arctoides* and in its nearest relative *M. nemestrina*, it ranged from 162-179 days (Kuehn, Jensen and Morrill 1965; Tokuda, Simons and Jensen 1968). Regarding birth of babies, Webb-Peploe (1947) stated that in southern India, lion-tail babies were born in September; Prater (1971) also stated that young lion-tails were seen regularly in September. Sugiyama (op. cit.) noted that lion-tail young were born in January and that there was no restricted mating season. Sankhala and Desai (op. cit.) reported seven lion-tail births from January to October, indicative of breeding throughout the year.

At the Ranibaug Zoo Garden, Bombay, there were three lion-tail monkeys added in April 1973. Gadgil and Ramaswami examined them regularly starting from January 1976. Another consignment of lion-tails, 2 males and 3 females, was added to the Zoo on 23rd November 1976 after rescuing them from a local dealer and housing them for a few months in the Karnala National Park, Maharashtra. Of the first lot of three females, two were regularly cycling even in the absence of a male and the third one had not reached menarche. Female No. 1 of this lot was in menses on 9th January 1976. Usually there is both overt/occult menses of 2-2.5 days in these animals and the vaginal swabs disclosed the latter type. The next menstruation in this female was on 16th February 1976; the cycle was of 38 days. Again she menstruated on 17th March; this cycle was of 30 days. The third cycle which we studied on 4th April 1976 was of 20 days duration. This animal was again studied during the end of 1976 and the following year. She menstruated on 9th December 1976; 16th January 1977; 23rd February and 3rd April; these consecutive cycles were of 39 days duration. The second female also showed similar consecutive cycles of 39-40 days duration. Asakura (1960) reported a cycle length of 39.6 days in the lion-tail (under its older specific name *albibarbata*) and menses of 2.5 days in the zoo lion-tails studied by him in Japan. In our animals, we studied the cyclical nature of the sex skin in relation to the menstrual cycle. The growth of the sex skin started from day 6/7 and on day 10 of the menstrual cycle, the sex skin was highly tumescent and it continued in this condition for another 11-12 days. The subcaudal sex skin was reniform, either side of it projecting above the tail ; these side projections eclipsed the perianal swellings and by pushing the subcaudal above, the perianals could be made out. The perivulval were the largest swellings and each one enclosed the ischial callosity of its side and at the height of tumescence, the vulval region, pink in colour, was not visible externally. We have never noticed the right and left perivulval sex skin uniting to form a single one as described by Hill (1937). The ischial callosities were soft at this time and were completely embraced by the sex skin. From days 22-27 of the cycle, detumescence was noticed and this was completed well before the beginning of the next cycle. The perianal and perivulval swellings completely detumesced quickly, the skin showing more and more shrinkage and the ischial callosities becoming hard again ; the subcaudal swelling was no more reniform but persisted for a few more days as a prominent swelling at the base of the tail into the next cycle. From the day detumescence started, it took 17-18 days for the next catamenia to occur. According to Asakura (op. cit.), the sexual skin cycle was of 14.5 days duration. Fooden (1975) draws a figure (Fig. 11, p. 29) of the posterior of the lion-tail, based on the work of Pocock (1925) and of Hill (op. cit.), and compared it with that in the pigtail *M. n. nemestrina.* The figure of the lion-tail was a poor representation of what we have seen on more than one occasion in the same lion-tail in the zoo and also in other lion-tail females. His figure was of a lion-tail from the Lincoln Park Zoo showing the beginning of tumescence and the maximum development of the sex skin had yet to take place.

If, as in the pigtail, baboon (Hendrickx and Kraemer 1970) and the chimpanzee (Keeling and Roberts 1972), ovulation took place at the peak of tumescence and prior to the onset of detumescence in the lion-tail monkeys, it would be around days 21-22 of the cycle when the female was at the height of the heat period ; it was during this period that frequent copulations took place. No discharge of mucus was noticed during this period. The luteal period was probably 18 days. According to Sugiyama (op. cit.), the sexual skin surrounding the anus and vulva of an oestrous female may or may not be swollen. We have always seen swollen sex skin in cycling female lion-tails at the height of the follicular phase.

Two sets of workers (Kuehn, Jensen and Morrill op. cit. ; Tokuda, Simons and Jensen op. cit.) reported that the cycle length in the pigtail was 32-40 days. According to the latter authors, the tumescent and quiescent periods of the sex skin were 21 and 17 days respectively. In the same species, Bullock, Paris, Resko and Goy (1968) noted that ovulation took place on the first day of detumescence ; this observation was confirmed by a study of plasma oestradiol and progesterone assay by Eaton (1973). White, Blaine and Blakley (1973) described that vaginal cytology and body temperature did not help in pinpointing the day of ovulation in the pigtail. Perineal tumescence helped in separating the luteal phase from the follicular ; maximal tumescence was seen within 12 hrs of ovulation. In a cycle length of 28 or 29 days, the maximum swelling lasted 1-3 days in three different cycles. In a further study of the pigtail monkey, Blakley, Blaine and Morton (1977) pointed out that ovulation and the first signs of detumescence occurred within a 24 hrs period.

Gillman (1935) reported that in the baboon there was a sudden decrease in all measurements of the sex skin at midcycle and then reached a maximum within the next two or three days ;

he associated the decrease with ovulation in this animal.

At the Bombay Zoo Garden, just before the sex skin started detumescing in a female lion-tail (22-23 December 1976), a male, which had been received from the Karnala National Park, was introduced into the cage ; the female was a regularly cycling one which we had studied. He mounted her several times and each time there were five pelvic thrusts. The mode of copulation resembled that in other macaques (Tokuda 1961-62). The female did not conceive. However, at a later date, a male baby was born on 24th July 1979. This baby has grown up nicely and goes about moving out of the cage, receiving eatables etc., and then gets back into the cage. When Ramaswami examined the baby on 30th March 1981 (with the assistance of veterinarian Dr. M. S. Karawale) he was looking healthy and was aged 1 year, 8 months and 10 days ; weaning had not yet taken place. The Zoo has seven lion-tails, 5 females and 2 males, one of the latter being the juvenile referred to above.

Our examination of the vaginal cytology of the female lion-tails disclosed an interesting evidence of the possible time of ovulation. At the height of tumescence and before the start of detumescence (22-23 days of the cycle), large number of cornified cells (superficial cells) were noticed in the smear, stained pinkish by the Papinacoloau technique ; no other cells were present. This probably was also the time of ovulation. Such scales also appeared in lesser numbers in the smears in the days following the start of detumescence (noticed as shrinkage of the sexual skin) and they do not show any rolled edges as in the luteal phase smear of the human female (Jeffcoate op. cit.). As the female approached the day of menses, the smear swab showed a pink colour as in the human female and thereafter both overt and occult menses took place. Leucocytes and cyanophilic intermediate cells preponderated in the menstrual smear while in the days following menses, there were scales, a few intermediate cells and a few leucocytes. This appeared to be the general pattern of cell types during menstruation studied over a large number of cycles in two females. The occurrence of a large number of only superficial cells coinciding with the height of tumescence (21-22 days of the cycle) would restrict the time of ovulation to those days and the secretory phase started from day 22-23 when the sex skin also started shrinking. The vaginal temperature was of no use in deciding the day of ovulation.

At the Kolhapur Zoo Garden (Maharashtra), there are two pairs of lion-tails ; no records of these have been maintained. One female gave birth to a male baby. No further conceptions took place. This may be due to the very aggressive nature of both the males which kept the females in a state of tension.

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Our sincere thanks are due to the authorities of the Ranibaug Zoo Garden, Bombay and particularly to Drs. M. V. Wani and R. D. Patil for making all necessary arrangements for examination of the female lion-tails and for conducting mating experiments etc., and later (30th March 1981) to Dr. M. S. Karawale who provided details from registers and allowed me to photograph the juvenile lion-tail along with its mother, and to the officials of the Children's Park Zoo, Guindy, Madras and particularly to Sri C. Narayanaswamy for helping in the examination of the female lion-tail there.

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Since sending the Ms. to the press and receiving the galley proof, there has been a Conference on the lion-tailed monkey at Baltimore, U.S.A. Comprehensive accounts of studies made on the monkey at various zoos were reported at the Conference by Lasley, Czekala, Lindburg, Shideler, Fitch (San Diego Zoo) and Kempske (Baltimore zoo) and an account of the reproductive behaviour of the animal in wild has been given by Kumar and Kurup. Both Drs. Kurup and Gadgil attended the Conference and from the Mss. brought by the former, the following highlights are culled:

1. The male is a multiple mount ejaculator (Kumar & Kurup; Lindburg).

2. The menstrual cycle is of 30 days duration (Lasley, Czekala & Lindburg) or 30-36 days (Kempske) and ovulation (using the oestrogen peak as a parameter) takes place around 14th day of the cycle and the luteal phase is of 16 days. The reported difference in cycle length is due to differences in the follicular phase of duration. It has also been shown in their Table that estrone of the oestrogens is the major urinary metabolite (Lasley, Czekala & Lindburg) like many other monkeys.

3. The sex-skin behaviour is highly variable and therefore not dependable for pinpointing the day of ovulation in the lion-tail macaque.

4. The period of pregnancy may range from 154-186 days (mean 172 days) (Kempske).

5. The animals are not short-lived as opined by Green & Minkowski from their study in wild and have been living for more than 33 years in the Baltimore zoo.

6. In wild population, the sex-skin swelling lasts for 34.33 days; copulation thrusts are 3-16. Conception takes place during June-July (S.W. monsoon) and December (N.E. monsoon) (Kumar & Kurup).

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TAXONOMIC SIGNIFICANCE OF SPERMATHECA IN SOME INDIAN GRASSHOPPERS (ORTHOPTERA : UCRIDIDAE)[1]

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(*With twenty-three text-figures*)

Comparative study of spermatheca was made on twenty-three species representing twenty genera of the family Acrididae and its taxonomic significance is shown. Presence or absence of apical diverticulum, length and shape of apical and pre-apical diverticula of spermatheca are considered as characters of generic significance. The species studied are arranged under their respective subfamilies.

INTRODUCTION

The spermatheca is also known as *receptaculum seminis*, is an essential part of female reproductive system in which the spermatozoa are stored, and ejected upon eggs as the latter passed from the oviduct. Slifer & King (1936), Slifer (1939, 1940 a, b, c, 1943), Katiyar (1956) and Dirsh (1957) have shown the taxonomic significance of spermatheca in various subfamilies of Acrididae. We made an attempt to make a comparative study of spermatheca in twenty-three species representing nine subfamilies of Acrididae with a view to discover its significance for the identification of grasshopper genera. The species studied are assigned under their respective subfamilies.

MATERIAL AND TECHNIQUES

Adult specimens were collected from the central district of Manipur and Aligarh district of Uttar Pradesh. The apical half of the abdominal region was cut off and boiled in a test tube containing 5% KOH solution till the structure becomes transparent. Later, this was transferred to water and washed thoroughly for complete removal of KOH. It was then dissected under a dissecting binocular microscope with the help of fine needles in order to take out the spermatheca. After this, the normal process of dehydration was adopted and clearing was done in clove oil. The spermatheca was mounted in Canada-balsam under a 22 mm² cover glass. The slides were kept in a thermostat at a temperature of approximately 40°C for about four days to make it complete dry. Drawings were made with the help of camera lucida.

SPERMATHECA IN ACRIDIDAE

Subfamily : PYRGOMORPHINAE

1. **Chrotogonus trachypterus** (Blanchard) (fig. 1)—Apical diverticulum absent, pre-apical diverticulum long, tubular and curved. The same condition has been shown in *Chrotogonus* sp. by Slifer (1940a, fig. 20) and in *Chrotogonus concavus* Kirby by Katiyar (1956, fig. 3f).

2. **Poekilocerus pictus** (Fabricius) (fig. 2)—Apical diverticulum absent, pre-apical diverticulum long, tubular and curved. The same condition has been shown in *Poekilocerus vittatus* (Klug) by Uvarov (1966, fig. 88j).

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3. **Atractomorpha crenulata** (Fabricius) (Fig. 3)—Apical and pre-apical diverticula well developed, tubular and elongated. The former slightly longer and narrower than the latter. The same condition has been shown in *Atractomorpha ambigua* (Bolivar) by Slifer (1943, fig. 3).

Subfamily : HEMIACRIDINAE

4. **Hieroglyphus banian** (Fabricius) (fig. 4)—Apical diverticulum uniformly long and tubular, pre-apical diverticulum well developed. The same condition has been shown in *Hieroglyphus annulicornis* (Shiraki) by Slifer (1940b, fig. 59) and in *H. banian* (Fabricius), *H. concolor* (Walker) and *H. nigrorepletus* Bolivar by Katiyar (1956, figs. 2d-g).

5. **Spathosternum prasiniferum** (Walker) (fig. 5)—Apical diverticulum with basal half broader, shorter than the pre-apical diverticulum. Pre-apical diverticulum uniformly broad and curved. The same condition has been shown in the same species by Katiyar (1956, fig. 1i).

Subfamily : OXYINAE

6. **Oxya intricata** (Stal) (fig. 6)—Apical diverticulum long, bearing a small protuberance at its apical one-fifth ; pre-apical diverticulum broad and curved, thrice the width of apical diverticulum. The same condition has been shown in *Oxya adentata* Will. by Slifer (1940b, fig. 90).

7. **Oxya velox** (Fabricius) (fig. 7)—Almost similar with *Oxya intricata* except absence of protuberance on apical one-fifth of the apical diverticulum. The same condition has been shown in the same species by Slifer (1940b, fig. 91). The presence or absence of protuberance on apical diverticulum has a specific taxonomic significance.

Subfamily : EYPREPOCNEMIDINAE

8. **Choroedocus robustus** (Serville) (fig. 8)—Apical diverticulum uniformly broad, shorter than the pre-apical diverticulum, which is broader. The same condition has been shown in *Heteracris calliptamoides* Uvarov by Slifer (1940b, fig. 56).

9. **Eyprepocnemis alacris** (Serville) (fig. 9)—Apical diverticulum long and tubular, truncated at apex ; pre-apical diverticulum narrow at basal half and broadened at apical half. The same condition has been shown in *Eyprepocnemis shirakii* Bolivar by Slifer (1940b, fig. 51) and in *Eyprepocnemis roseus* Uvarov by Katiyar (1956, fig. 1f).

Subfamily : CATANTOPINAE

10. **Catantops pulchellus** (Walker) (fig. 10)—Apical diverticulum long and slender, narrower than pre-apical diverticulum, uniformly broad and bow-shaped. The same condition has been shown in *Catantops brunneri* Karny by Slifer (1940b, fig. 124) and in *Catantops humilis humilis* (Serville) and *Catantops splendens* (Thunberg) by Katiyar (1956, fig. 1c & d).

Subfamily : CYRTACANTHACRIDINAE

11. **Cyrtacanthacris tatarica** (Linnaeus) (fig. 11)—Apical diverticulum long and slender, longer and narrower than pre-apical diverticulum ; pre-apical diverticulum broad and horseshoe shaped.

Subfamily : ACRIDINAE

12. **Acrida exaltata** (Walker) (fig. 12)—Apical diverticulum short, apex truncated, shorter than pre-apical diverticulum ; pre-apical diverticulum is sac-like. The same condition has been shown in *Acrida gigantea* (Herbst) (fig. 13)

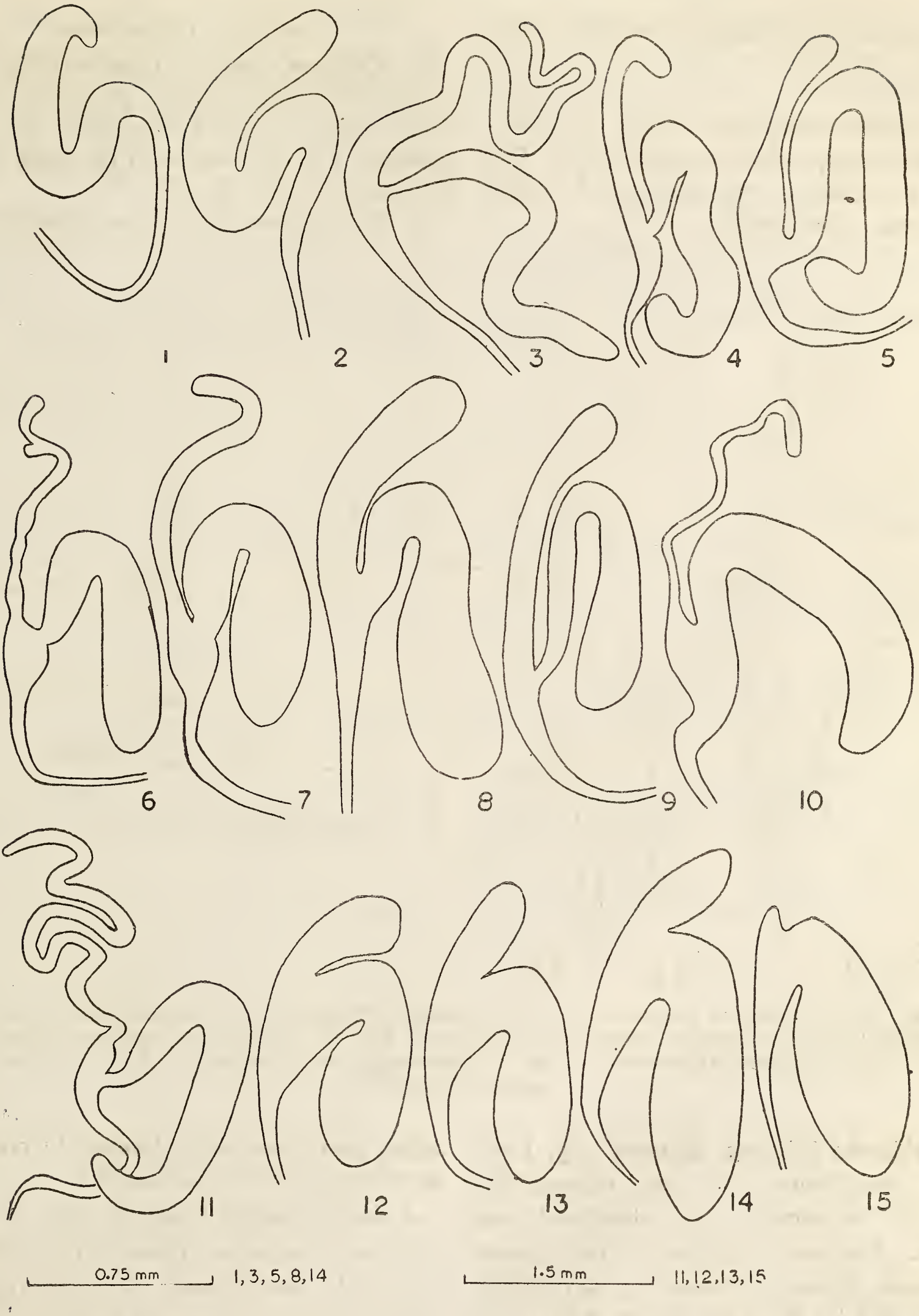
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Fig. 1. *Chrotogonus trachypterus* (Blanchard); Fig. 2. *Poekilocerus pictus* (Fabricius); Fig. 3. *Atractomorpha crenulata* (Fabricius); Fig. 4. *Hieroglyphus banian* (Fabricius); Fig. 5. *Spathosternum prasiniferum* (Walker); Fig. 6. *Oxya intricata* (Stal); Fig. 7. *Oxya velox* (Fabricius); Fig. 8. *Choroedocus robustus* (Serville); Fig. 9. *Eyprepocnemis alacris* (Serville); Fig. 10. *Catantops pulchellus* (Walker); Fig. 11. *Cyrtacanthacris tatarica* (Linnaeus); Fig. 12. *Acrida exaltata* (Walker); Fig. 13. *Acrida gigantea* (Herbst); Fig. 14. *Ceracris nigricornis* (Walker); Fig. 15. *Phlaeoba infumata* (Brunner).

and in *Acrida turrita* (Linnaeus) by Slifer (1939, fig. 2).

14. **Ceracris nigricornis** Walker (fig. 14)—Apical diverticulum short, apex truncated. Pre-apical diverticulum long and broad, longer than apical diverticulum.

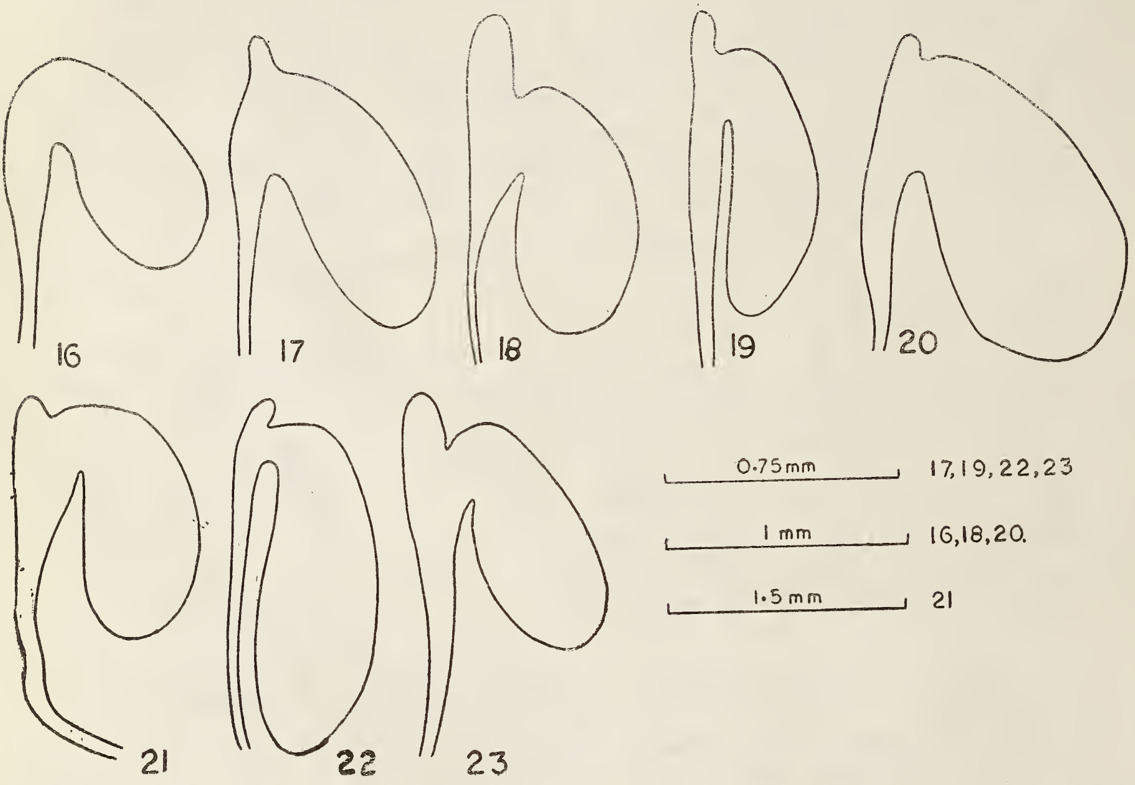

Fig. 16. *Oedaleus abruptus* (Thunberg); Fig. 17. *Aiolopus affinis* (Bolivar); Fig. 18. *Trilophidia annulata* (Thunberg); Fig. 19. *Acrotylus humbertianus* (Saussure); Fig. 20. *Gastrimargus transversus* (Thunberg); Fig. 21. *Locusta migratoria* (Linnaeus); Fig. 22. *Dociostaurus decisus* (Walker); Fig. 23. *Dociostaurus apicalis* (Walker).

15. **Phlaeoba infumata** Brunner (fig. 15)—Apical diverticulum short and tubercle-like, pre-apical diverticulum well developed and sac-like. The same condition has been shown in *Phlaeoba infumata* Brunner by Slifer (1939, fig. 49) and in *Phlaeoba panteli* Bolivar by Katiyar (1956, fig. 1b).

Subfamily : Oedipodinae

16. **Oedaleus abruptus** (Thunberg) (fig. 16)—Apical diverticulum absent, pre-apical diverticulum broad and much developed. The same condition has been shown in the same species by Katiyar (1956, fig. 3d).

In the following species the apical diverticulum short, not much developed; pre-apical diverticulum broad and sac-like.

Aiolopus affinis (Bolivar) (fig. 17);

Trilophidia annulata (Thunberg) (fig. 18);

Acrotylus humbertianus (Saussure) (fig. 19);

Gastrimargus transversus (Thunberg) (fig. 20);

Locusta migratoria (Linnaeus) (fig. 21);

The same condition has been shown in *Aiolopus tamulus* (Fabricius), *A. thalassinus* (Fabricius) ; *Acrotylus insubricus* (Scop) ; *Gastrimargus africanus* (Saussure) and *Oedaleus senegalensis* (Krauss) by Slifer (1939), (figs. 7, 8, 63, 76 and 84).

Subfamily : GOMPHOCERINAE

Apical diverticulum short, pre-apical diverticulum broad and sac-like in *Dociostaurus decisus* (Walker), *D. apicalis* (Walker) (figs. 22, 23). In *Dociostaurus anatolicus* Krauss apical diverticulum well developed (Slifer 1939, fig. 23).

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A CATALOGUE OF THE BIRDS IN THE COLLECTION OF THE BOMBAY NATURAL HISTORY SOCIETY—25

Muscicapidae

Humayun Abdulali

[*Continued from Vol. 79* (1) : 151]

This part deals with 636 specimens of 96 species and subspecies. The babblers do not fly long distances and being restricted to relatively small and sometimes isolated habitats have often broken up into distinct races which may or may not indicate any reaction to the environment.

The present study has resulted in the revalidation of one subspecies and the description of another, and it is quite possible that suitable series from different places may warrant the recognition of more races.

The earlier part of the work was assisted by Shri Selvaraj, Research Assistant at B.N.H.S.

1152. **Pellorneum ruficeps punctatum** (Gould) (Kalka, Bhagat, Simla) Western Spotted Babbler 1:241

3 : 2 ♀♀ 1 o?

1 Kalka, 1 Bhagat State, 1 Simla.

This is a distinct but very restricted form. Measurements on p. 352.

1153. **Pellorneum ruficeps mandellii** Blanford (Sikkim) Mandelli's or Sikkim Spotted Babbler 1:240

13 : 5 ♂♂ 8 ♀♀

1 Kesarwala, 1 Dehra Dun, U.P.; 1 Dingla, 1 Bijaypur, Nepal; 1 Kurseong 4700′, 1 Pershoke 2600′, Sikkim; 1 Darjeeling, 1 Jalpaiguri, Bengal; 2 Samchi, West, 2 Lodrai, Central, Bhutan; 1* Phulguri, N. Kamrup, Assam.

*Specimen missing and subspecies undetermined.

Of the two from Dehra Dun ♂ No. 25900 d/17.7.74 is more olive-brown above and closer to *punctatum* while the other ♀ 16043 agrees with those listed as *mandelli*, several of which show a varying amount of black tipping to the feathers of the forehead.

Measurements on p. 352.

1154. **Pellorneum ruficeps ruficeps** Swainson (Nilgiris) Spotted Babbler 1:238

37 : 18 ♂♂ 12 ♀♀ 7 o ?

1 Rajpipla Town, 1 Songarh, Navsari, 1 Malegaon, 1 Pipri, 1 Laochali, Surat Dangs, Gujarat; 1 Pili, Melghat, Berar; 1 Borivili, 1 Andheri, Bombay; 1 Khandala, Pune: 1 Karwar, 1 Potoli, N. Kanara; 3 Molem, Goa; 1 Mercara, Coorg; 1 Ulavi, Sorab, Mysore; 1 Begur, Manantoddy, 1 Devon Nellacotta, Wynaad; 1 Kurumbapatti, Salem; 4 Anantgiri, 2 Sankrametta, 1 Velaspara, near Sileru, 2 R. V. Nagar, Vizagapatam Ghats; 1 Barsur, 1 Antagarh, 1 Darba, Bastar, 1 Bhanuprattapur, Kanker, C.P., 2 Badrama (Bamra), 1 Kudildka (Nilgiris), 2 Berbera, Puri, Orissa.

In the birds from Sankrametta and Anantgiri the spots on the underparts are restricted to a band across the upperbreast, while they extend further down in the Nilgiri specimen [H.R. Baker, Segoor 4000′ Nilgiris, from British Museum (N.H.)]

As indicated when describing *pallidum* (*JBNHS* 79, p.153) suitable series from different parts of the country may permit the description of additional races. A series of topotypes is also necessary to permit determination of its range, particularly on the west and south.

Measurements on p. 352.

1154a **Pellorneum ruficeps pallidum** Abdulali (Palkonda Hills) Eastern Ghats Spotted Babbler

10 : 8 ♂♂ 2 ♀♀ (♂ No. 1259 from Palkonda Hills is type)

2 Shevaroy Hills 3,500 and 4,000 ′, 2. Chitteri Range 2000-3000′ Salem dist., 6 Palkonda Hills, S. Cuddappah.

This subspecies occupies the area indicated by the specimens listed and is bordered both on the south and north by birds now accepted as of the nominate race.[1]

Measurements on p. 352.

1155. **Pellorneum ruficeps granti** Harington (Mynall, Travancore) Kerala Spotted Babbler 1:240

3 ♂♂ (1* immature)

1 Parambicolam, Cochin ; 1 Thattakad, N. Travancore, 1* Maraiyur 3500′ Travancore.

The bird from Maraiyur shows a redness on the upperparts which may be the erythrism referred to by Deignan.

In 1839 Jerdon described *olivaceum* from Trichur, Wadakancheri and Manantoddy, and as suggested by the name this was a ' dark brownish olive above ', but he was admittedly not conversant with any other *Pellorneum* with a rufous head and suspected that what he had described might be the same as the original *P. ruficeps*. In *Birds of India* (1863, 2, pt.1. p.27) he placed it in the synonymy of *ruficeps*, and here it remained and was not referred to by Harington who described *granti* ' an altogether much darker and richly coloured form ' on the basis of a specimen from Mynall in the British Museum and another from Travancore received on loan from the Travancore Museum. In 1947, Deignan reviewing the races of this species revived Jerdon's *olivaceum* and restricted the type locality to Trichur for ' though within a stone's throw of the Nilgiris ' (the type locality of *ruficeps*), it was furthest therefrom among the three places mentioned by Jerdon. Stuart Baker's extension of *granti* to the Wynaad and Malabar was discredited by Kinnear & Whistler. Though there is little doubt that there is a dark race in the extreme south-west and Deignan was well aware of Jerdon's decision regarding *olivaceum*, it does appear curious that he should have revived the name without examination of any specimen of either this form or *granti*.

When working on *pallidum*, the British Museum (N.H.) sent me a specimen obtained by H.R. Baker at Segoor 4000′, Nilgiris. This differed from those from the extreme south-west in having a paler back with an olive wash.

Allowing for the effects of fading and the variation in plumage over the rest of India in specimens attributed to *ruficeps*, this agrees with one from Begur, Manantoddy, Wynaad (one of Jerdon's type localities for *olivaceum*) and others from Wynaad, Malabar, Mysore, Coorg, Mercara, Goa, and further north along the Western Ghats, though the colour of the upperparts does become paler north of Bombay. The freshest (1972) specimens from Goa have their upperparts almost as dark as in *granti* but with an olive tinge above and the spotting restricted to the breast. In addition to the general darkness of plumage, *granti* is more heavily streaked in front and has no touch of olive above.

It would, in my opinion, be better to leave *olivaceum* as a synonym of *ruficeps* and accept the name *granti* for the darker bird in the south-west. The identity and distribution of this species in the different hill ranges in the south-west still requires a lot of clarification.*

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[1] British Museum (N.H.), Tring, sp. No. 1845, 1.10.21 marked ' Madras ' is quite indistinguishable.

Measurements on p. 353.

1156. **Pellorneum ruficeps chamelum**** Deignan (Gunjong, Cachar) Assam Spotted Babbler

6 : 3 ♂♂ 3 ♀♀

1 North C., 1 Garumara (?), 1 Cachar ; 1 Cherrapunji, 1 Lait Kaisen, Khasi Hills; 1 Rewa Tea Estate, South Sylhet.

The rufous on the head is paler than in *mandelli* and the upperparts more rufous in series, being most pronounced in the bird from Cherrapunji (1906)

Measurements on p. 353.

1157. **Pellorneum ruficeps pectorale** Godwin-Austen (Sadiya, Assam)

2 ♂♂ Tezu, Lohit Valley, N.E. Assam.

In one of the two the black on the mantle is more prominent than in any under *mandelli.*

Measurements on p. 353.

1158. **Pellorneum ruficeps ripleyi**** Deignan (Margherita, Assam) Lakhimpur Spotted Babbler

nil.

1159. **Pellorneum ruficeps vocale** Deignan (Kanglatongbi, Manipur) Manipur Spotted Babbler

nil.

EL. **Pellorneum ruficeps stageri** Deignan [N'Pon Village (on left bank of Irrawaddy, 15 miles north of Myitkyina, Myitkyina Dist., Sagaing Division, Burma)]

2 o ? Kamaing, Myitkyina, Burma.

The underparts are heavily streaked on the breast and at the sides.

Measurements on p. 353.

EL. **Pellorneum ruficeps shanense** Deignan (Ma-li-pa, lat. 23° 41′N., long. 98° 46′E. Kokang State, Burmese WA State)

5 : 1 ♂ 4 o ?

1 *Laikaw*, 1 *N. Shan States* ; 1 *South Shan States* 1 *Loikaw, Kantarawadi, Karenni ;* 1 *Thaudaway Karen Hills*, 20 *m north of Toungoo, Burma.*

The dark centres to the feathers of uppermost back obsolescent and almost absent in the last specimen (No. 1286) which also differs in having very fine streaks on the upper breast.

Measurements on p. 353.

EL. **Pellorneum ruficeps hilarum** Deignan [Kyundaw (lat. 21° 01′N., long. 94° 35′E.) Pakokku Dist., Magwe Division, Burma]

1 ♀ *Maymyo, Mandalay Dist.*

Rufous of head, crown and nape paler ; feathers of uppermost back have the dark brown centres less distinct than in *shanense.*

This single specimen is named largely on the basis of the distribution in Deignan's paper.

Measurements on p. 353.

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* After completion of this work, I had the opportunity of examining the large number of specimens of this species at the British Museum (Natural History) at Tring which confirmed the general conclusions referred to above. In the large series from Matheran and Mahabaleshwar are 2 juveniles which resemble the adults in the colour of the upper parts, but the spots on the breast are replaced by sooty brown downy feathers which form a band across the breast.

** In the second edition of the Synopsis, (1982) Ripley has combined both *chamelum* and *ripleyi* with *mandellii.*

EL. **Pellorneum ruficeps minus** Hume (Thayetmyo, Thayetmyo Dist., Magwe Division, Burma) 1 : 242

4 : 1 ♂ 3 ♀♀

1 *Kyuzin, Arakan Yomas*; 1 *Panktaing*, 1 *Kanaza, Henzada Dist.*, 1 *Ngapali, Sandoway Dist., Burma.*

There is some variation in the colour of the upperparts but they were all placed with *minor* (*minus*) by Ticehurst, *JBNHS* 37 p. 863. The uppermost back is marked and the breast very sparsely and finely streaked.

Measurements on p. 353.

EL. **Pellorneum ruficeps subochraceum** Swinhoe (Tenasserim provinces, restricted to Moulmein, Amherst Dist. by Deignan) Malay Spotted Babbler 1:239

2: 1♂ 1♀

1 *Rangoon*, 1 *Ataran.*

The uppermost backs are unmarked as in Indian *ruficeps* and *granti.*

Measurements on p. 353.

EL. **Pellorneum ruficeps insularum** Deignan (Domel Island, lat. 11° 37′N., long. 98° 16′E., Mergui Archipelago, Mergui Dist., Tenasserim Div., Burma)

1 o?

Mergui, Tenasserim.

A poor skin but very rufous all over.

Measurements on p. 353.

The Burmese specimens have all been marked *mandelli/minor* by earlier workers prior to Deignan's revision.

1160. **Pellorneum palustre** Gould (Cachar, Assam) Marsh Spotted Babbler 1:242

2 : 1 ♂ 1 ♀

1 Hassemara, 1 Gagaldhubir, North Lakhimpur, Assam. ♂ ♀ Wing 64, 62 (62-68) ; bill 14.5, 14 (c. 15) ; tail 66, 63 (64-69)

The two specimens look very different from the picture in IND. HANDBOOK (Pl. 70 facing p. 176 in vol. 6).

1161. **Pellorneum fuscocapillum fuscocapillum** (Blyth) (Colombo, Ceylon) Browncapped Babbler 1:245

See under 1163.

1162. **Pellorneum fuscocapillum babaulti** (Wells) (Trincomalee, Ceylon) Pale Browncapped Babbler 1:245

See under 1163.

1163. **Pellorneum fuscocapillum scortillum** (Ripley) (Rakwana, Ceylon) Dusky Browncapped Babbler

2 : 1 ♀ 1 o?

1 *Walgama*, 1 *Passava, Ceylon.*

In the absence of additional material it is not possible to say if these are darker or paler, but if the first place is read ' Weligama ' which is at the southern tip of the island, it would distributionally appear to be *scortillum* as is confirmed by some of the colour factors. The other has a darker bill and a deeper chestnut on the upper breast.

♀ o? Wing 65, 70 ; bill 16.5, 15.5 ; tail 54,58.

1164. **Pellorneum albiventre albiventre** (Godwin-Austen) (Manipur Valley) Assam Brown Babbler 1:243(part)

4 : 2 ♂♂ 1 ♀ 1 o?

2 Margherita, Assam ; 1 Gunjong, N. Cachar ; 1 *Chin Hills, Burma.*

Measurements on p. 353.

1165. **Pellorneum albiventre ignotum** Hume (Sadiya, N.E. Assam) Mishmi Brown Babbler 1:243

2 ♂♂ Tezu, Lohit Valley, Upper Assam.

The one unbroken bill is much heavier than in those in 1164 above and the colour much deeper though this may partly be due to fading in the nominate birds which were collected in the early part of the century. See note on variations in species (Ripley & Hall, Ibis 1954 pp. 486/7).

Measurements on p. 353.

1166. **Trichastoma tickelli assamensis** (Sharpe) (Dhollah, Assam) Tickell's Babbler 1:248

11 : 5 ♂♂ 6 ♀♀

1 Dibrugarh, 8 Margherita, 1 Rewa Tea Estate, S. Sylhet; 1 Gunjong, N. Cachar, Assam.

Measurements on p. 353.

1167. **Trichastoma abbotti abbotti** (Blyth) (Ramree I., Arakan) Abbotts' Babbler 1:260

13 : 10 ♂♂ 2 ♀♀ 1 o ?

1 Sukna, Darjeeling; 1 Lodrai, Central Bhutan; 3 Goma Reserve, Goalpara, 1 Doyang, 1 Dibrugarh, 1 Rewa Tea Estate, S. Sylhet; 1 Gawkhand, 2 Cachar, Assam; 2 Lankapakala, nr. R. V. Nagar, Vizag. Dist., A.P.

The recent specimens from Lodrai (1967) and Doyang (1952) and two males from Lankapakola show more olive-green and less rufous on the upperparts. Checklist vol. X (1964) p. 255 accepts Koelz's *amabilis* from Nichuguard, Naga Hills, Assam.

Two males from Lankapakala, Vizagapatam Ghats, obtained by Salim Ali on 2nd and 3rd March 1981 show more olive-green and are slightly larger than the northern birds (wings 79, 80, tail 51, 53). The bills are also darker. Comparison with fresh specimens from the north and east may warrant separation. They add appreciably to the recorded distribution of the species.

Measurements on p. 353.

1168. **Pomatorhinus horsfieldii* leucogaster** Gould (Himalayas = Simla) West Himalayan Slatyheaded Scimitar Babbler 1 : 208

7 : 6 ♂♂ 1 ♀

4 Kalka 2500-3000', 1 Bhagat State, Ambala Dist., 1 Simla Hills, 1 Bhimtal, Kumaon.

See remarks under 1169.

Measurements on p. 354.

1169. **Pomatorhinus horsfieldii schisticeps** Hodgson (Nepal) East Himalayan Scimitar Babbler 1:207

9 : 8 ♂♂ 1 o ?

2 Bhutan Duars; 1 Pashoke, 1 Singhtam, Teesta Valley, Sikkim; 1 Mangdechu, C. Bhutan, 1 Balasun, Darjeeling, 1 Laisung 1 Hungrum, North Cachar, 1 Cachar.

In INDIAN HANDBOOK (6:129) the key to subspecies requires that this race should have a wing over 100 mm, and *leucogaster* under 100. Only two of the specimens available have a wing slightly over 100 mm and though *schisticeps* average a shade larger within the limit, I cannot separate them by their measurements. *Leucogaster* have a rufous wash on the upperparts while *schisticeps* are olive-green and have a more distinct cap. In *schisticeps* the bill is higher and creates a more curved effect.

The specimen from Bhimtal, Kumaon, agrees more closely with *leucogaster* though the distribution accepted in IND. HANDBOOK would make it *schisticeps*. The three from Cachar have been named by Dr. Ripley to whom they were send for opinion as they appeared to agree more closely with *mearsi* Ogilvi-Grant (TAUNGDWIN, CHAUNG lat. 22°52′N., long. 94°20′E, (Lower Chindwin) as in Stuart Baker's *Fauna*.

Measurements on p. 354.

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* The specific name has been changed from *schisticeps* in SYNOPSIS (1982)

1170. **Pomatorhinus horsfieldii salimalii** Ripley (Tezu, Mishmi Hills, N.E. Assam)

1 ♂ Sadiya, Upper Assam.

The single specimen has a broad band of rufous round the neck, but the ear-coverts do not appear noticeably darker than in those under *schisticeps*.

Measurements on p. 354.

1171. **Pomatorhinus horsfieldii cryptanthus** Hartert (Margherita) Lakhimpur Slatyheaded Scimitar Babbler 1:207

2 : 1 ♂ 1 ♀ Dibrugarh, Assam.

The pair from Dibrugarh is a rich rufous all over the upperparts.

Measurements on p. 354.

1172. **Pomatorhinus horsfieldii obscurus** Hume (Mount Aboo) Mt. Abu Scimitar Babbler 1:211

3 o ? Mount Aboo.

The upperparts are greyer than in *horsfieldii* though the variation in the latter makes some of them not very different.

Measurements on p. 354.

1173. **Pomatorhinus horsfieldii horsfieldii** Sykes (Mahabaleshwar, Western Ghats) Indian Scimitar Babbler 1:210

31 : 15 ♂♂ (2 juv. 1 imm.) 16 ♀♀ (1 juv. 2 imm.)

1 Songadh, Navsari, 1 Lavcholi, 2 Mahal, 1 Waghai, Surat Dangs, Gujarat; 1 Chikalda, 1 Pili, Melghat, Berar ; 1 Bhimashankar, 1 Khandala, Pune; 1 Thane Hills, 1 Malad, 1 Borivli, Salsette, Bombay ; 1 Castle Rock, 1 N. Kanara ; 1 Talewadi, Belgaum ; 1 Mercara, Coorg ; 1 Sakleshpur, Hassan, 2 Billaiji, Billigirirangan Hills, Mysore ; 2 Sankrametta, 1 Anantgiri, Vizagapatam Hills, 5 Bailadilla, Baster, M. C. ; 1 Berberi, Puri, 2 Mahendragiri, 1 Rasul, Handol, Orissa.

In most specimens the head is darker than the back forming a varyingly distinct cap, which is never black as in *travancoreensis*. The two from the Billigirirangan Hills can be included with the latter but are left here in deference to Whistler's opinion.

The 3 juveniles from Mahal, Surat Dangs (2) and Kamela, Bailadilla, Bastar, have rufous ear-coverts, rufous on the sides of the white plastron and a wash on the upperparts. The black tips to the white feathers of the lower throat referred to in INDIAN HANDBOOK are not visible. Three more from Bailadilla listed as 'immature' indicate a later plumage in which the underparts are as in adults, but there is a rufous wash above. These plumages resemble those of the adult slaty-headed races from the north and east and a comparative study of the juveniles of the several races described would be of great interest.

Measurements on p. 354.

1174. **Pomatorhinus horsfieldii travancoreensis** Harington (Peermade, Travancore) Kerala Scimitar Babbler 1:211

17 : 9 ♂♂ 6 ♀♀ 2 o ?

1 Bandipur, Mysore; 1 Coonoor, Nilgiris; 1 Thekkaddy, Periyar Lake ; 1 Munnar, 1 Maraiyur, 3 Devicolum, High Range, N. Travancore: 4 Shembaganur, 2 Kodaikanal, 1 Palni Ghat ; 1 Balamore, Ashambu Hills, S. Travancore; 1 High Wavy Mountains, Madura.

The darkness of the head created by the black tips to the feathers varies to some extent but is the best character for separating them from *horsfieldii*.

Measurements on p. 354.

1175. **Pomatorhinus horsfieldii maderaspatensis** Whistler (Kurumbapatti, Salem dist., Madras) Tamil Nadu Scimitar Babbler

5 : 3 ♂♂ 1 ♀ 1 o ?

2 Kurumbapatti (topotypes), 1 Chitteri Range, Salem dist.; 1 Shevaroy Hills, S. Cuddappah, 1 Palkonda Hills, Chitoor, Tamil Nadu.

This race is said to lack the black edging to the white plastron, but in the specimens available this does not appear to be a very distinct character for separation from the widely-ranged *horsfieldii.*

Measurements on p. 354.

1176. **Pomatorhinus horsfieldii holdsworthi** Whistler (Chiya, Ceylon)

See below.

1177. **Pomatorhinus horsfieldii melanurus** Blyth [Uragaha (restricted by Whistler) Ceylon] 1:212

5 : 3 ♂♂ 2 ♀♀

2 Hakgalla, 1 Ratnapura, 1 Kandy, 1 Kudava, Sinharaja, Ceylon.

From the literature available Nos. 2977 ♂ and 2976 ♀ both from Hakgalla can be listed as of the two races said to occur in Ceylon, the male being *holdsworthi* with an olive brown back, and the female like all the others with rufous backs. Only one (♂ 25754) from Kudava has a black tail (*melanurus*?). In Peters' CHECKLIST (1964, X, p. 270) the race *holdsworthi* is not accepted, a fact with which Ripley has now agreed (*in epist.*).

Measurements on p. 354.

EL. **Pomatorhinus horsfieldii nuchalis** Tweeddale (Thayetmyo, Burma) Tweeddale's Scimitar Babbler 1:208

1♂ *Maymyo* (?), *Burma.*

Wing 85, bill 25, tail 82.

The ear-coverts are olive-grey like the top of the head.

EL. **Pomatorhinus olivaceus olivaceus** Blyth (Ye, Amherst dist., Tenasserim) Tenasserim Scimitar Babbler 1:209

1 ♂ *Zamni River, Ataran, Tenasserim, Burma.*

Nominate *olivaceus* is said to be more rufous-brown above than *ripponi*, but one from the type locality of *ripponi*, i.e. N. Shan States is more rufous above! The single specimen of *olivaceus* has its bill longer than in those of the next race. Both *olivaceus* and *ripponi* are listed as races of *schisticeps* in Peters' CHECKLIST.

Measurements on p. 354.

EL. **Pomatorhinus olivaceus ripponi** Harington (N. Shan States) Harington's Scimitar Babbler 1:210

5 : 1 ♂ 1 ♀ 3 o?

1 *Loi Kan, N. Shan States*; 1 *Sintaung*, 12 *miles from Taunggyi, S. Shan States*, 1 *Maymyo*; 2 col. by J.P Cook but no data.

One of the two without data is albinoid, the coloured parts being replaced by pale grey. The single specimen from the N. Shan States is more rufous than the specimen from the type locality of nominate *olivaceus* q.v., but the others are greyish olive rather than rufous-brown above.

Measurements on p. 354.

1178. **Pomatorhinus ruficollis ruficollis** Hodgson (Nepal, restricted to Khatmandu Valley) Rufousnecked Scimitar Babbler 1:216

3 ♂♂

1 Mandal, Chamoli, Garhwal; 1 Godaveri, Nepal; 1 Tongloo, Darjeeling dist.

The bird from Garhwal may be said to be olive-brown above, but all three differ from *bakeri* in having more prominent rufous collars on the hind neck. The underparts are also more brown and more distinctly streaked on the upper breast than *bakeri*, and the hind claw and tarsus appreciably shorter than in all the others except the single specimen from Mt. Victoria, Burma.

Measurements on p. 355.

1179. **Pomatorhinus ruficollis godwini** Kinnear (Chungkar, Trashigong, Duwengiri Road, S.E. Bhutan).

The specimens available from Sikkim and Bhutan fall into 2 groups (a) from Sikkim and Western Bhutan with a bright rufous collar, the rufous spreading on to the back which is also washed with rufous and (b) from eastern Bhutan (presumably from nearer the type locality) which are a deeper olive, less rufous above, and have the white of the upper breast more broadly marked with brownish streaks. The western birds also have their hind claw and tarsus slightly smaller though not so small as in nominate *ruficollis*. Curiously, only the brighter birds are marked *godwini* by Salim Ali and INDIAN HANDBOOK refers to the race as the *Sikkim* Rufousnecked Scimitar Babbler. In view of my inability to map the various places mentioned in Bhutan I am leaving the two apparent forms found in this area together under *godwini* and leaving it to some future worker to disentangle the problem :

(*a*) 6 : 4 ♂♂ 2 ♀

1 Temi, 1 Kewzing-Temi, West, 1 Rinchingpong, Sikkim ; 1 China Kothi, 1 Chapcha, West Bhutan ; 1 Bomdila, A.P.

(*b*) 10 : 5 ♂♂ 5 ♀♀

2 Gedu, Western Bhutan ; 2 Shamgong, Central Bhutan ; 4 Wamrong, 1 Narphong, 1 Rongtong, Eastern Bhutan.

Measurements on p. 355.

1180. **Pomatorhinus ruficollis bakeri** Harington (Shillong) Harington's Rufousnecked Scimitar Babbler 1:217

3 ♂♂ Shillong, Assam.

The underparts are a paler brown with indistinct streaking, and altogether less rufous than others from the west.

The hind claw is also the smallest.

Measurements on p. 355.

EL. **Pomatorhinus ruficollis** subsp.

1 o ? *Mt. Victoria, Burma.*

This (May 1906) is rufous above and below, much smaller than the others and has the rufous collar indistinct. Though INDIAN HANDBOOK (6:140) refers to *bakeri*'s occurrence mostly between 2000 and 3000 metres on Mt. Victoria, this appears quite different in colour and size from those under 1180.

Measurements on p. 355.

1181. **Pomatorhinus erythrogenys erythrogenys** Vigors (Simla-Almora area) West Himalayan Rustycheeked Scimitar Babbler 1:220

20 : 8 ♂♂ 7 ♀♀ (1 juv.) 5 o ?

1 Koroar, Kishtwar, Kashmir; 2 Taradevi, 1 Patiala ; 1 Kalka, 7 Simla; 3 Mornaula, 1 Kumaon ; 1 Kemol, 7 m. north of, 1 Mussoori, 2 Kanan Jaunsar, U.P.

The juvenile is washed with rufous above, more so on the head, and is paler rufous below with a small white chin patch. One from Kumaon (No. 1140) has the chin faintly spotted.

Measurements on p. 355.

1183. **Pomatorhinus erythrogenys haringtoni** Baker (Darjeeling) Sikkim Rustycheeked Scimitar Babbler 1:220

20 : 14 ♂♂ 5 ♀♀ 1 o ?

1 Godaveri, 1 Bouzami, 1 Khatmandu, Nepal; 2 Rinchinpong, West, 1 Ranjeet Valley, 2 Pashok Tea Estate, Sikkim; 1 Somchi, West, 5 Tama, Central, 1 Deothang, 2 Rongtong, East, 1 Khosela, Bhutan, 1 Kurseong, 1 Longview Tea Estate, Darjeeling.

All three birds from Nepal have pale spots on the throat (tending towards *haringtoni* in which the spots are much darker) and making the whole throat grey. If Hodgson's description of *ferrugilatus* from Nepal applied to these birds, would it be reasonable to discard the name as it applied to an intermediate form and then synonymise it with the form with a pure white throat (nominate *erythrogenys*), as is now done?

Measurements on p. 355.

1184. **Pomatorhinus erythrogenys mcclellandi** Godwin-Austen (Khasia Hills) Assam Rusty-cheeked Scimitar Babbler 1:221

6 : 1 ♂ 3 ♀♀ 2 o ?

3 Shillong, Khasi Hills, 2 Sadiya, n.e. Assam; 1 *Chin Hills, Burma.*

Measurements on p. 355.

EL. **Pomatorhinus erythrogenys odicus** Bangs & Phillips (Mengtsz, Yunnan)

2 o ? *North Shan State, Burma.*

The black markings on the throat separate it from other Indian & Burmese races. They were identified by Drs. Salim Ali & Dillon Ripley.

Measurements on p. 355.

1185. **Pomatorhinus hypoleucos hypoleucos** (Blyth) (Arakan) Large Scimitar Babbler 1:222

2 : 1 ♂ 1 o ? Rupachena, Cachar, Bangladesh.

Measurements on p. 355.

1186. **Pomatorhinus ferruginosus ferruginosus** Blyth (Darjeeling) Sikkim Coralbilled Scimitar Babbler 1:213

3 : 1 ♂ 2 ♀♀

1 Tama, Central Bhutan; 2 hills around Benichuga, 3500′, Upper Assam.

Measurements on p. 356.

1187. **Pomatorhinus ferruginosus formosus** Koelz (Tura Mountain, Garo Hills) Assam Coralbilled Scimitar Babbler

2 : 1 ♂ 1 ♀

1 Guilong, 1 Hungrum, N Cachar.

They have a thin black line over the supercilium, the bills are longer than in *phayrei*, and the underparts a richer rufous, though the ♂ is darker than the female. There must however be considerable variation in colour for Stuart Baker (*JBNHS* 8:178) refers to nests of *ferruginosus* and *phayrei* both being found at the same place in North Cachar on the same day (as also nests of *Pomatorhinus erythrogenys* and *mcclellandi*!).

Measurements on p. 356.

1188. **Pomatorhinus ferruginosus phayrei** Blyth (Arracan) Mizo Coralbilled Scimitar Babbler 1:214

2 : 1 ♀ 1 o ?

1 Mokichang, Naga Hills; 1 *Chin Hills, Burma.*

Both have the underparts slightly paler than in the two marked *formosus*. None of the four (*formosus* and *phayrei*) have a distinct cap on the head. The bird from the Chin Hills is within the accepted range of this race, while the bird from the Naga Hills should according to INDIAN HANDBOOK (6, p. 146) and Ripley (*JBNHS* 77 p. 3) be *formosus*. The present material however is more in keeping with Koelz's statement when describing *formosus* that those from the Naga and Lushai (Mizo) Hills are similar to *phayrei*.

Measurements on p. 356.

1188a. **Pomotorhinus ferruginosus namdapha** Ripley (Bhimraj Camp. 40 m east of Miao, Noa Dihing Road, 27° 40′N., 97°E. approx., Arunachal Pradesh)

3 : 2 ♂♂ 1 ♀ paratypes

The underparts of this newly-described race are much paler than in any of the other races dealt with, and there is a black line over the white supercilium meeting on the forehead.

Measurements on p. 356.

1189. **Pomatorhinus ochraceiceps stenorhynchus** Godwin-Austen (near Sadiya, Assam) Mishmi Longbilled Scimitar Babbler 1:219

2 ♂♂ Dening Valley, N. E. Assam.

Measurements on p. 356.

1190. **Pomatorhinus ochraceiceps austeni** Hume (E. Manipur) Hume's Scimitar Babbler 1:218

1 ♀ Mokichang, Naga Hills.

Slightly washed with rufous on underparts. Measurements on p. 356.

EL. **Pomatorhinus ochraceiceps ochraceiceps** Walden (Shan States) 2:217

1 ♂ *Yangte, North Shan States, Burma.*

The rufous on the head merges into that of the back.

Measurements on p. 356.

1191. **Xiphirhynchus superciliaris superciliaris** Blyth (Darjeeling) Slenderbilled Scimitar Babbler 1:224

6 : 3 ♂♂ 3 o ?

1 Gedu, 3 Honka, West, 1 Narphong, East, Bhutan ; 1 no data.

Sp. No. 20787 with no data has the head and chin different from the others, but it does not agree with the description of *X. s. intextus* Ripley.

Measurements on p. 356.

1192. **Xiphyrhynchus superciliaris intextus** Ripley (Dreyi, Mishmi Hills, N.E. Assam) Assam Slenderbilled Scimitar Babbler

nil.

1193. **Rimator malacoptilus malacoptilus** Blyth (Darjeeling) Longbilled Wren-Babbler 1:251

3 ♂♂ Honka, W. Bhutan.

Measurements on p. 356.

1194. **Napothera brevicauda striata** (Blyth) (Khasia Hills) Streaked Wren-Babbler. 1 : 251

2 : 1 ♂ 1 ♀

2 Margherita, Upper Assam.

In spite of the specific name, the tail is longer than in the next species.

Measurements on p. 356.

1195. **Napothera epilepidota roberti** (Godwin-Austen & Walden) (Chakha, Manipur) Austen's Small Wren-Babbler 1:253

nil.

1196. **Napothera epilepidota guttaticollis** (Ogilvie-Grant) (Miri Hills, Assam) Grant's Wren-Babbler 1:254

2 ♀♀ (1 fledgling), Margherita, Assam

The fledgling, downy and rufous all over (with a deeper cap) was obtained by Coltart and marked *Corythocichla squamata* as also the adult, both within a week in April 1902. *Squamata* was described by Stuart Baker in *JBNHS* 13 p. 403 from Cachar and in the next volume p. 626, he synonymised it with *Napothera* (*epilepidota*) *roberti* which name is marked on the fledgling by a subsequent worker too. However *squamata* was described from Cachar, and if the specific identification is correct the name should be *N. e. guttaticollis* for Margherita is in the accepted range of this form and not *roberti.* The adult also has a reddish cap. The identifications have been confirmed by Dr. Ripley.

Measurements on p. 356.

1197. **Pnoepyga albiventer pallidior** Kinnear (Dharmsala, Punjab) Western Scalybreasted Wren-Babbler

7 : 5 ♂♂ (3 white) 1 ♀ 1 o ?

1 Bhagat State 3500′, 1 Koti State 8300′, 1 Keonthal State 8500′, 1 Patiala State 5000′, 3 Simla.

The three white birds, Simla (2) and Bhagat State are all males. Oates and Stuart Baker both held that the males were white and the females fulvous below, but INDIAN HANDBOOK refers to these differences as dimorphic. I have been unable to find any information as to whether both forms are found in the same flock or not. The upperparts of these birds are a duller brown than in the nominate race, but these are all older and this may be due to fading.

Measurements on p. 356.

1198. **Pnoepyga albiventer albiventer** (Hodgson) (Nepal, restricted to Chandragiri, above Thankot in Nepal Valley) Eastern Scalybellied Wren-Babbler 1:458

16 : 9 ♂♂ (2 white) 3 ♀♀ (2 white, 1 juvenile, brown) 4 o ? (2 white)

1 Moyan Village, Nepal; 2 Chungthang, N. Sikkim; 1 Darjeeling; 1 Tongloo; 2 Monha, 2 Gedu, 2 Chimakothi, 1 Phuntshaling, West B. 1 Shangong, Central B.; 1 Wamrong, 2 Gomchu, Eastern Bhutan.

INDIAN HANDBOOK 6 p. 157 refers to each feather on the underparts being white (or fulvous) with a dark centre and 'a narrow dark margin producing a very scaly effect'. The scaly effect is certainly there but the margin is white and not dark. Here also only one white bird (1959) skinned by Gobind Bahadur (?) is a female. ♀ Specimen No. 2146 a juvenile in brown plumage from Darjeeling was sent to Dr. Ripley and he writes that as it does not agree with the published descriptions it should be recorded that the specimen is quite clearly marked with narrow pale lines on the centre of the feathers of the breast giving a striated appearance and pale spots in the centre of the feathers of the abdomen and belly with dark margins giving a scalloped appearance which is distinct from the uniform brown in the earlier published descriptions.

Measurements on p. 357.

1199. **Pnoepyga pusilla pusilla** Hodgson (Nepal) Brown Wren-Babbler 1:459

20 : 12 ♂♂ 4 ♀♀ 4 o ?

5 Dikchu, Gangtok, Sikkim; 1 Buxa, 2 Hasimara, Bhutan Duars; 2 Gedu, 1 Samchi, West B.; 5 Shajgong, Central Bhutan; 3 Margherita, 1 Laisong, N. Cachar Hills, Assam.

This, like the last, is another extraordinary species with a white and a rufous phase. Of the 7 white birds, 6 are males. The most consistent difference between this species and *albiventer* is that of the size of the wing and tarsus which are exclusive. Both species have been obtained at Gedu, West Bhutan.

Measurements on p. 357.

1200. **Spelaeornis caudatus** (Blyth) (Darjeeling) Tailed Wren-Babbler 1:456

2 ♀♀ 1 Honka, West, 1 Shamgong. Central Bhutan.

Measurements on p. 357.

1201. **Spelaeornis badeigularis** Ripley (Dreyi, Mishmi Hills, N.E. Assam) Mishmi Wren-Babbler

nil.

1202. **Spelaeornis longicaudatus** (Moore) (Khasi Hills, Assam) Longtailed Wren-Babbler 1:452

nil.

1203. **Spelaeornis chocolatinus chocolatinus** (Godwin-Austen & Walden) (Hangrum, N. Cachar) 1:450 & 453

nil.

1204. **Spelaeornis chocolatinus oatesi** (Rippon) (Mt. Victoria) Chin Hills Longtailed Wren-Babbler 1:455

nil.

1205. **Spelaeornis troglodytoides sherriffi** Kinnear (Dongna La between Lingtse and Trashi Yangtsi, East Bhutan 10,500′) Spotted Longtailed Wren-Babbler

nil.

1206. **Spelaeornis formosus** (Walden) (Darjeeling) Spotted Short-tailed Wren-Babbler 1:449

1 ♂ Honka, W. Bhutan.

Measurements on p. 357.

1207. **Sphenocichla humei humei** (Mandelli) (Sikkim) Sikkim Wedgebilled Wren 1:461

nil.

1208. **Sphenocichla humei roberti** Godwin-Austen & Walden (Hemes Peak, North Cachar hills) 1:461

nil.

1209/10. **Stachyris ruficeps & S. rufifrons**

The identification of 22 specimens of the two species accepted as *Stachyris ruficeps* Blyth and *S. rufifrons ambigua* Harington has revealed more ambiguities than in any others which I can recall.

Blyth's original description of *ruficeps* (1847) from Darjeeling as well as Hume's *rufifrons* from Pegu (1873) referred to birds with white chin and throat and made no reference to yellow anywhere in the plumage. Hume when describing *rufifrons* said it was slightly smaller, had the rufous of the head duller and not extending to the occiput, the upper surface wanting the greenish olive tinge and the lower surface wanting the oil yellow tinge of *ruficeps*. Blanford's Fauna (1898) referred to a yellow chin, fulvous yellow lores and whitish or dull oil yellow underparts in *ruficeps*. For *rufifrons* it required a white chin and throat, a more restricted rufous cap on the head and ' otherwise mostly as in *ruficeps* '.

In 1914, Harington dealing with the Indian Timalidae, upset some of the earlier descriptions and named *S. rufifrons ambigua* from Cachar as with a whitish chin and throat, not contrasting with the lower plumage and with yellow lores. Of the new race, the underparts were said to be pale fulvous and not a rich tawny buff.

Stuart Baker in the second edition of the Fauna (1922) left *ruficeps* with a pale yellow chin and bright yellow lores and said that in *ambigua* the chin was whitish and the lores yellow. In recent years there has been more confusion and a footnote in INDIAN HANDBOOK (6, p. 170) states the birds from the Mishmi Hills named *rufifrons* by Ripley were actually *ruficeps*, and in Synopsis (1982 footnote to p. 334) he (Ripley) describes a new subspecies named by Koelz by comparison with two different species!

It is evident that there is considerable confusion, and the best I have been able to do is to divide them into 2 provisional groups.

1209. **Stachyris rufifrons ambigua** Harington (Gunjong, N. Cachar) Red-fronted Babbler 1:270

13 : 8 ♂♂ 4 ♀♀ 1 o ?

1 Peshoke, 2,600′, Sikkim : 1 Deothang, E. Bhutan ; 1 Dibrugarh, 1 Sadiya, 3 Margherita, Assam ; 1 N. Cachar; ....1 Chakola, Simlipal Hills, Mayurbhang, 1 Mahendragiri, Orissa ; 1 R. V. Nagar, 2 Sankrametta, Vizagapatam Hills, Andhra Pradesh.

The birds from Assam and peninsular India in Orissa and the Eastern Ghats can immediately be distinguished by the white chin, pale brown upper and tawny underparts and the absence of any yellow on the chin and lores. Mr. Colin Harrison of the British Museum to whom a draft copy of this note was sent has drawn attention to the fairly distinct transverse zone of warm ochraceous buff across the upper breast present in the material at the British Museum. This certainly separates all of them from *ruficeps*. They also agree with Hume's description of *rufifrons* from Pegu, but in the absence of any topotype this is admittedly insufficient and needs comparison with birds from Burma.

Measurements on p. 357.

1210. **Stachyris ruficeps ruficeps** Blyth (Darjeeling) Redheaded Babbler 1:268

9 : 3 ♂♂ 2 ♀♀ 4 o ?

1 Gedu, West, 1 Shamgong, 2 Batase, Central, 2 Gomchu, 1 Rongtong, East Bhutan; 1 Darjeeling, Bengal; 1 Bomdila, Arunachal Pradesh.

The bird from Darjeeling is badly foxed and is placed here on the basis of the name placed thereon many years ago. The others have whitish chins & throats streaked with black, oily yellow underparts, an olive wash above and distinctly yellow below. The bird from Gedu is marked *S. rufifrons ambigua* by B. Biswas and the others have also been accepted as of this form. The rufous on the head is in series more extensive than in the 1209 above. They agree more closely with the original description of *ruficeps*, and lack the brownish band across the breast. If this radical correction is not made, we would have no specimens of this species in our collection.

There is some variation in the colour of the underparts but without more representative series from different places it is not possible to gauge their significance.

Measurements on p. 357.

1211. **Stachyris pyrrhops** Blyth (Nepal) Black-chinned Babbler 1:271

11 : 2 ♂♂ 5 ♀♀ 4 o ?

2 Koti, 1 Bhagat, 1 Kalka, 1 Simla, 1 Simla Hills; 1 Dhanaulti, Mussoorie, 1 Bageshwar, 1 Almora, 1 Kumaon, U.P.; 1 Bans Bahari, Nepal.

Measurements on p. 358.

1212. **Stachyris chrysaea chrysaea** Blyth (Nepal) Golden-headed Babbler 1:265

(*a*) 3 : 2 ♂♂ 1 o ?

1 Gedu, 1 Honka, West, 1 Tama, Central Bhutan.

(*b*) 5 : 1 ♂ 4 ♀♀

4 Miao, 1 Deban, Tirap div., Arunachal Pradesh.

The birds from Miao (1979) are much brighter yellow below than those under (a) the brighter gold marking on the head forming an eye-stripe, while the yellow wash above is more distinct. A ♀ obtained in January 1982 at Deban is the brightest and it is evident that the intensity of colour diminishes rapidly in a few years.

Measurements on p. 358.

1213. **Stachyris chrysaea binghami** Rippon (Mount Victoria, lat. 21° 15′N., long. 93° 55′E., Upper Burma) 1:266

3 : 2 ♂♂ 1 ♀

1 Ratane, Dibong Valley, Mishmi Hills, 2 Margherita, Assam.

The upperparts are greyish olive and the underparts with a very pale yellowish wash. Ear coverts slaty green.

Measurements on p. 358.

1214. **Stachyris nigriceps nigriceps** Blyth (Nepal) Black-throated Babbler 1:264

13 : 6 ♂♂ 3 ♀♀ 4 o ?

1 Pashok T. E.; 1 Dikchu-Gangtok, Sikkim; 1 Samchi, 1 Phuntsholing West, 2 Mangdechu, 1 Sham-

gong, 1 Lodrai, Central, Bhutan; 1 Hornbill Camp, 2 Miao, Tirap; 1 Kolaktong, Arunachal Pradesh; 1 ? (E. C. S. Baker)

Ripley has withdrawn his race *coei* (Dreyi, Mishmi Hills) and this facilitates grouping.

Measurements on p. 358.

1217. **Stachyris nigriceps coltarti** Harington (Margherita, Assam) Nagaland Black-throated Babbler 1:265

8 : 3 ♂♂ 4 ♀♀ 1 o ?

1 Ratane, Dibong Valley, Mishmi Hills, 1 Sadiya, 3 Margherita, 1 Laikensew, Khasi Hills; 1 *Dalu*, 1 *Kamaing, Upper Burma.*

These have a uniformly black chin and darker underparts than the nominate form. Ripley has synonymised his race *spadix* (Laisung, N. Cachar) with this form.

Measurements on p. 358.

1218. **Stachyris oglei** (Godwin-Austen) (Sadiya, Assam) Austen's Spotted Babbler 1:262

4 : 1 ♂ 3 ♀♀

2 Miao, 1 Tirap, Arunachal Pradesh; 1 Margherita, Assam.

Measurements on p. 358.

1219. **Dumetia hyperythra abuensis** Harington (Mount Abu) Mt. Abu White-throated Babbler 1:230

5 : 4 ♂♂ 1 ♀

2 Vaghjipur, Mehsana Dist., 1 Cambay City Environs, 1 Dabka, Baroda, 1 Pandwa, Surat Dangs, Gujerat.

See remarks under 1220.

Measurements on p. 358.

1220. **Dumetia hyperythra navarroi** Abdulali (Khandala) Whitethroated Babbler

17 : 13 ♂♂ 2 ♀♀ 2 o ?

2 Padgha, Bhiwandi, Thana; 1 Goregaon, 1 Ratory, Malad, 1 Chembur, 1 Trombay, Salsette, Bombay; 1 Murud, Kalyan; 2 Kihim, Alibag, Kolaba; 5 Khandala, 1 Lonavla, Poona; 2 Ratnagiri.

Navarroi was described on the basis of specimens from Khandala, Salsette (Bombay), Padgha (Thane) and Kihim (Kulabe District). Though accepted in Ripley's Synopsis (1951) it was synonymised with *abuensis* in INDIAN HANDBOOK (1971, 6 p. 178) with no word of explanation. A re-examination of the material available reveals that among the whitethroated forms, *abuensis* can be separated from *navarroi* by the bright chestnut on the forehead extending beyond the crown and in which every feather has a pale centre bordered with rufous creating a shiny and bristly appearance. They all have pale yellow bills.

South of this is *navarroi* (type Khandala) with the heads a deeper brown and the bills darker. The feathers on the head do not show the shiny centres. In addition to the colour differences, this race is slightly smaller than both *abuensis* to the north and *albogularis* to the south.

Further south the brown on the head again becomes chestnut but this is restricted to the forehead and does not extend as far as the crown. Their bills are paler, though not as yellow as in *abuensis*.

Under the circumstances, it seems advisable to retain three races along the western side of the country.

The two from Padgha (Nos. 20107 and 21877), Thane are intermediate with *abuensis* while those from Ratnagiri approach *albogularis*.

Measurements on p. 358.

1221. **Dumetia hyperythra albogularis** (Blyth) (Southern India restricted to Mysore by Baker) Whitethroated Babbler 1:229

25 : 15 ♂♂ 5 ♀♀ 5 o ?

1 Karwar, 1 N. Kanara ; 1 Peermade, High Range, 1 Balamore, Ashambu Hills, Kerala; 2 Billigirirangan, 1 Shenemanelle, Coimbatore; 1 Kalhatri, (J.P. Cook= 1894=S. I.?), 5 Kurumbapatti, 1 Chitteri Range, 1 Gingee, S. Arcot; 1 Seshachalam, 5 Palkonda Hills ; 1 Kodura, S. Cuddapah, 1 Shevaroy Hills, 1 Nallamalai Range ; 1 *Upper Burma* ? ?

In the northernmost bird from Nallamalai Hills the white patch on the throat is smaller than in the others. In the last the label reads 'Upper Burma ? ?' and collected by a Major Radcliffe and is no doubt erroneous.

Measurements on p. 359.

1222. **Dumetia hyperythra hyperythra** (Franklin) (Ganges near Benares) Rufous-bellied Babbler 1:228

22 : 11 ♂♂ 8 ♀♀ 3 o ?

2 Narwar Fort, 1 Gwalior ; 1 Saronj, Tonk State, Vidisha ; 2 Chikalda, Berar ; 2 Paryat, 1 Jubbulpore ; 1 Gondia; 1 Nelipaka, 1 Borgampod, 1 Kaulas, 1 Paloncha, Hyderabad ; 1 Chota Dongar, 1 Amraoti,Bastar ; 2 Lohatter, Kanker ; 1 Korlea, Bilaspur ; 2 Sankrametta, Vizagapatnam Ghats, 1 Tikerpara, Augul dist., Orissa.

Measurements on p. 359.

1223. **Dumetia hyperythra phillipsi** Whistler (Kumbalgamuwa, Ceylon, 3000′) Ceylon White-throated Babbler

1 o ? Hambantuta, Ceylon.

Bill heavy and pale brownish yellow. Upperparts dullish and with slight rufous on forehead.

Measurements on p. 359.

1224. **Rhopocichla atriceps atriceps** (Jerdon) (Trichoor-Wynaad) Blackheaded Babbler 1:281

14 : 8 ♂♂ 5 ♀♀ 1 o ?

1 Molem, 1 Conacona, Goa ; 1 Karwar, 3 N. Kanara; 1 Mercara, Coorg ; 2 Cherambodi, 2 Gudalur, Nilgiris ; 1 Wynaad ; 2 Honametti, Billigirirangans.

The key to subspecies in INDIAN HANDBOOK 6, p. 182 is a little confusing. The heads are black rather than dark brown.

Measurements on p. 359.

1225. **Rhopocichla atriceps bourdilloni** (Hume) (Mynall, Travancore) Kerala Black-headed Babbler 1:282

7 : 1 ♂ 4 ♀♀ 2 o ?

1 Thattakad, North T., 1 Tenmalai ; 1 Peermade, Central T., 1 Ponmudi, 1 Muthukuzi, Ashambu Hills, 1 Kutyani, South Travancore ; 1 Madura.

There are some differences in the amount of rufous on the upperparts, but as Whistler has stated they are very liable to 'museum browning'. The colour of the head of the two races is very distinct.

Measurements on p. 359.

1226. **Rhopocichla atriceps siccatus** Whistler (Kalawewa N.C.P. Ceylon) Ceylon Dry Zone Blackheaded Babbler

2 : 1 ♂ 1 ♀

1 Panadura, 1 Bible (Uva) Ceylon.

The ♂ from Panadura has a little black on the forehead and ear-coverts and may be of the next race.

Measurements on p. 359.

1227. **Rhopocichla atriceps nigrifrons** (Blyth) (Uragaha, S.P., Ceylon) Ceylon Wet Zone Blackheaded Babbler 1:282

3 ♂♂

1 Uragaha, 2 Kudava, Sinharaja, Ratnapur dist., Ceylon.

Masurements on p. 359.

1228. **Macronous gularis rubricapilla** (Tickell) (Borabhum, Bihar) Yellowbreasted Babbler 1:273

37 : 19 ♂♂ 14 ♀♀ 4 o ?

The birds show some variations in colour but it is not possible to isolate them. Birds from the Himalayas and eastwards are smaller than those from peninsular India and they are listed separately. Fresh specimens have more yellow on the breast.

(*a*) Peninsular India 22 : 12 ♂♂ 6 ♀♀ 4 o ?

1 Antasante, Mysore; 1 Lamasinghi, 3 Sankrametta, E. Ghats, 1 Minumulur, 2 R. V. Nagar, Vizagapatam dist.; 1 Antagarh, 1 Dantawara, Bastar, M.P.; 1 Bailadila, 3 Badrama (Bamra), 2 Berbera, 1 Kutri, Daspalla, 1 Barsur, 2 Upper Barakamra, 1 Orissa; 1 Manbhoom, Bihar.

(*b*) 15 : 7 ♂♂ 8 ♀♀

2 Berrick, Sikkim; 1 Lodrai, 2 Gaylegphug, 1 Deothang, Central Bhutan; 1 Kuchigan, 1 Goma Reserve, Goalpara; 2 Sadiya, 1 Dayong, 1 Sonarupa, Assam; 1 Miao, Arunachal Pradesh; 1 Cherapunji, 1 Margherita, Assam.

Measurements on p. 359.

EL. **Macronous gularis ticehursti** (Stresemann) [Dudaw Taung (lat. 21° 05′N., long. 94° 19′E.).

7 : 5 ♂♂ 1 ♀ 1 o ?

1 *Maymyo*, 1 *Thayank*, 1 *Lindon*, *Thayetmyo*; 1 *Kandian*, *Prome*; 1 *Nagapali*, *Sandoway*, *Arakan*; 1 *Kyibin*, *Henzada*; 1 *Nathan Village*, *Bassein*, *Burma*.

The finer streaks on the throat and upper breast are noticeable.

Measurements on p. 359.

1229. **Timalia pileata bengalensis** Godwin-Austen (Khasi Hills) Redcapped Babbler 1:226

11 : 5 ♂♂ 4 ♀♀ 2 o ?

1 Kumaon Terai, U. P.; 1 Sukhera, Darjeeling; 3 Goalpara, 2 Dibrugarh, 1 Lakhimpur, Assam; 1 Miao, Arunachal Pradesh; 2 *Upper Burma*.

Measurements on p. 360.

EL. **Timalia pileata intermedia** Kinnear (Pegu Div., Lower Burma)

2 ♀♀

1 *Sindhi*, 1 *Tarokman*, *Prome*, *Burma*.

Measurements on p. 360.

1230. **Chrysomma sinense hypoleucum** (Franklin) (U.P., between Banares & Calcutta) Yellow-eyed Babbler

26 : 15 ♂♂ (6 juv. with horny bills) 9 ♀♀ (4 juv.) 2 o?

1 Lahore; 3 Bahawalnagar, 1 Jallunder, 2 Ambala, Punjab; 1 Bhagat State, N. W. Himalayas; 3 Bharatpur 4 Jaswantpura (Sunda Hills) Rajasthan; 2 Bhuj, Kutch; 1 Deesa, Palanpur, 1 Hingolgadh, Jasdan, 2 Baroda, 1 Rajpipla, Gujarat; 2 Gwalior, C.I.; 1 Jabbalpur, M.P., 1 Chikalda, Maharashtra.

The single specimen from Lahore has very noticeably grey underparts. Some specimens have their caps rufous, distinct from the rest of the upperparts. This appears to be a juvenile character, associated with a horny and not black bill.

Measurements on p. 360.

1231. **Chrysomma sinense sinense** (Gmelin) (China) Yellow-eyed Babbler 1:233

29 : 16 ♂♂ 9 ♀♀ 4 o ?

The birds from peninsular India were accepted as of this form by Whistler (*JBNHS* 35, p. 745) with the proviso that this was due to the sparsity of specimen from China in the British Museum. One of the two available had a 105 mm tail which is appreciably longer than the longest (97 mm) in Bombay. Separating *hypoleucum* from the north and northwest by their greyer upperparts, the southern birds are noticeably darker, but paler than those listed as *sinense* from Anantgiri and Sankrametta in the Vizagapatam Ghats and further eastwards. I am for the moment placing them in 2 groups :

(*a*) 13 : 7 ♂♂ 4 ♀♀ (1 juv.) 2 o ?

Intermediate in colour of upperparts.

1 Bhiwandi, 1 Padgha, Thana; 1 Goregaon, 1 Trombay, 1 Santa Cruz, Bombay; 1 South Konkan; 1 Terrania T. E., Nilgiris, 3 Kurumbapatti, Salem dist., 1 Palkonda Hills, 1 Koduru, 1 Seshachalam Hills. S. Cuddapah.

(*b*) 16 : 9 ♂♂ 5 ♀♀ (1 juv. with horny bill) 2 o ?

1 Anantapur, 1 Lamasinghi, 2 Sankrametta (Vizagapatam), Andhra Pradesh; 1 Bailadila, Bastar, Madhya Pradesh, 2 Koira (Bonai), 1 Chahala, Simlipal Hills Mayurbhanj, Orissa; 1 Kesarwala, Dehra Dun, U.P.; 1 Darjeeling, Bengal; 1 Goalpara, 1 Monai, Assam; 1 *Maymyo* 1* *Thayetmyo*, 1 *Sindi*, 1 *Takmaw*, *Prome dist.*, *Burma*. *albino.

In INDIAN HANDBOOK Ticehurst's *saturatior* from the Bhutan Duars is synonymised with the nominate form, but the single specimen from Darjeeling is noticeably darker than the others.

Measurements on p. 360.

1232. **Chrysomma sinense nasalis** (Legge) (Ceylon) Ceylon Yellow-eyed Babbler 1:235

1 ♀ Palamalla, S.P, Ceylon.

The keys to subspecies in both Stuart Baker's Fauna and INDIAN HANDBOOK refer to a black nostril which is separated from yellow nostrils in Indian birds. This character is hardly visible in dry skins, but the single specimen has much less rufous in the wings and on the upperparts and a very heavy bill.

Measurements on p. 360.

1233. **Chrysomma altirostre scindicum** (Harington) (Sukkur, Sind) Sind Babbler 1:237

nil.

1234. **Chrysomma altirostre griseigularis** (Hume) (Assam) Hume's Babbler 1:236

2 : 1 ♂ 1 ♀

1 Gagaldhubi, 1 Hassemara, N. Lakhimpur, Upper Assam.

Measurements on p. 360.

1152. *et al.* **Pellorneum ruficeps** subspp.

		Wing	Bill	Tarsus	Tail
1152.	*punctatum* 2 ♀♀ 1o ?*	69, 76, 76* (*IH* as in *mandelli*)	16.9, 17, 16*	25, 25, 24*	62, 73, 74*
1153.	*mandellii* ♂♂ (5)	67-78 av. 71.8 (*IH* 63-75	15-17.5 av. 16.2 from skull 18-21	21.5-25 av. 23.1 27-28	63-71 av. 67.2 70-77)
	mandelli ♀♀ (6)	67-72 av. 69.7 (*IH* 66-72	15.7-17.5 av. 16.4 from skull 18-20	23.2-25.5 av. 24.5 27-28	63-68 av. 65.3 62-70)
1154.	*ruficeps* ♂♂ (19)	70-79 av. 73 : 9 (*IH* 68-78	15-18.6 av. 16.7 from skull 17-20	23.6-28.5 av. 26 25-30	61-73 av. 67.7 61-73)
1154a	*pallidum* ♂♂ (9)	68-78 av. 73.3	17-18.8 av. 17.3	24-27.5 av. 25.5	58-70 av. 65
1154.	*ruficeps* ♀♀ (9)	69-78 av. 71 (*IH* 66-73	14.5-19 av. 16.3 from skull 16-20	24.5-27.5 av. 25.5 25-27	56-68 av. 62.4 57-69)
1154a.	*pallidam* ♀♀ (2)	70,70	17.5, 18.5	24.5, 24.7	64, 64

		Wing	Bill	Tarsus	Tail
1155.	*granti* ♂♂ (3)	74, 75, 75*	16, 17.2	25*, 26.3, 27	66, 66, 67*
	(1*imm.)	(*IH* 73-76	from skull 19-20	28-29	66-73)
1156.	*chamelum* ♂♂ (3)	72, 75,77	17, 18.1, 19	23.5, 23.5, 25.5	65, 67, 71
	chamelum ♀♀ (3)	69, 72, 75	16, 16.2, 16.8	25.5, 25.5, 25.7	63, 67, 71
		(IH as in *mandelli*)			
1157.	*pectorale* ♂♂ (2)	77, 77	18.1, 19	23.3, 25.5	70, 71
		(IH 70-76	from skull 18-20	..	67-74)
EL	*stageri* o ? (2)	70, 73	16.5, 17	25, 25.9	60 mltg, 72
EL	*shanense* 1 ♂	74	16.5	24.4	62
	4 o ?	65, 66, 76, 77	16.8, 17.5, 16.3, 16.5	23.3, 23.5, 24, 24.2	61, 63, 70, 75
EL	*hilarum* 1 ♀	67	16.9	26.1	64
EL	*minus* 1 ♂ 3 ♀♀	68 (4)	18.6, 16.6, 17.3, 17.5	23, 24.2 (2), 24.8	63, 60, 66, 67
		(C. B. Ticehurst JB 36 p. 922 measures the wings of 2 ♂♂ as 70 mm ; 2 ♀♀ 65.5, 66)			
EL	*subochraceum*	66, 63	16, 15	22.5, 21.6	61, 52
	1 ♂ 1 ♀	(Fauna 62-68 av. about 64)			
EL	*insularum* 1 o ?	64	15.6	23.5	60

1164-1165 Pellorneum albiventre albiventre/ignotum

1164.	*albiventre* (2)	56, 57	13, 15.1	20,22.1	53, 56
		(IH 58-60	from skull 14-15	22	47-59)
1165.	*ignotum* (2)	58, 61	18.7	22.5, 23	47, 48
		(IH 58-60	from skull 15	22	43-49)
1164.	*albiventre* ♀ (1)	57	13	21	50
		(IH 53-58	from skull 14-15	..	40-56)

1166. Trichastoma tickelii assamensis

♂♂ (5)	64-68 av. 66.6	13.5-15.2 av. 14.4	25-26.7 av. 26.4	49-56 av. 53.4
♀♀ (6)	62-69 av. 63.3	14.3-14.7 av. 14.5	21-27 av. 25.3	45-55 av. 50
	(♂♀ 64-67	..	..	50-55)

1167. Trichastoma abbotti abbotti

♂♂ (8)	74-77 av. 75	17.5-20 av. 18.4	22.5-25 av. 24	38, 44-52 av. 48
♀♀ (2)	75, 78	17.5-20	25,26	46, 51
	(IH♂♀ 74-80	from skull 20-21	25-26	47-52)

1168. *et al.* **Pomatorhinus horsfieldii** subspp.

	Wing	Bill	Tail
1168. *leucogaster* ♂♂ (6)	94-100 av. 97.6	25.7-29 av. 28	99-107 av. 102.8
leucogaster ♀ (1)	97	28.5	103
	(♂♀ 85-95 generally c. 90-91 mm.)		
1169. *schisticeps*			
♂♂ (8)	94-101 av. 98.3	28-30 av. 28.8	95-103 av. 99.2
♂♂	(IH 98-107	from skull 31-32	104-115)
♀♀	(IH 93-100	from skull 31-32	106-110)
1170. *salimalii* ♂ (1)	95	29.5	93
	(IH 94, 97	from skull 31, 33	95, 99)
1171. *cryptanthus* ♂♀	95, 94	29+, 26.5	91, 97
	(IH as in *schisticeps*)		
1172. *obscurus* o ? (3)	95, 95, 97	26.5, 28.7, 30.5	96, 96, 97
	(IH 7 ♂♀ Bill from skull 32-35, other measurements as in *horsfieldii* ex. Whistler)		
1173. *horsfieldii* ♂♂ (12)	97-101 av. 98.8	27-32 av. 30.3	92-101 av. 97
	(IH 91-100	from skull 29-35	95-102)
horsfieldii ♀♀ (13)	89-98 av. 94.4	27.2-32.5 av. 30.2	89-100 av. 94
	(IH 89-98	from skull 29-35	92-108)
1174. *travancoreensis* ♂♂ (9)	90-101 av. 95.2	23.7 av. 27.3	92-102 av. 96
	(IH 90-104	from skull 27-38*	94-107)
1174. *travancoreensis* ♀♀ (6)	90-96 av. 93	24-28.3 av. 26.2	91-98 av. 94
	(IH 85-98	from skull 28-33	93-100)
1175. *maderaspatensis* ♂♂ (3)	94, 99, 100	29, 29.3, 30.4	95, 99, 101
	(IH 89-100	from skull 29-33)	94-103)
maderaspatensis ♀ (1)	94	29.5	92
	(IH 90-98	from skull 30-38	91-98)
1177. *melanurus* ♂♂ (3)	90, 90, 91	25, 25.2, 27.5	84, 87, 88
	(IH 88-90	from skull 28	84-89)
melanurus ♀♀ (2)	87, 89	22.7, 24	84, 85
	(IH 86	from skull 28	84)

EL **Pomatorhinus olivaceus** subspp.

	Wing	Bill	Tail
nominate *olivaceus* 1 ♂	93	27.4	90
	(90-96	27-28	100-106)
ripponi 1 ♂ 1 ♀	89, 84	23.5, 23.6	93,85
3 o ?	89, 90, 91,	24.2, —, —	90, 92, 94
	(♂ ♀ 85-88	27-28	95-98)

1178. *et al.* **Pomatorhinus ruficollis** subspp.

		Wing	Bill	Tail	Tarsus	Hind claw
1178.	nominate *ruficollis* ♂♂ (3)	77, 80, 85	19.5, 22.2, 23.6,	85, 86, 90	25.6, 26, 28.4	10.4, 11, 13
	(IH ♂♀ ex. Kinnear	76-83	from skull 22-23	80-87	31-34	11-12)
1179.	*godwini* (*a*) ♂♂ (4)	79 (2), 80 (2)	20.5 (3), 22	82(2), 85	23, 27.5(2), 29.5	12.8, 13.8,14, 14.5
	♀♀ (2)	80, 81	21, 22.5	80, 85	27, 27.2	12.6, 14
	godwini (*b*) ♂♂ (5)	82-86 av. 84.4	21-22.3	83-95 av. 87.6	28-32 av. 30.4	13.5-15. 3 av. 14.4
		(IH 78-86	from skull 22-26	81-95	30-34	12-14)
	♀♀ (5)	80-82 av. 81	21-22.5	84-89 av. 86	30-32.5 av. 31.4	12-13 av. 12.6
		(IH 76-80	from skull 22-24	80-92	30-37	12-15)
1180.	*bakeri* (3) ♂♂ (3)	84, 86, 87	20.7, 21.5, —	88 (2). 90	28.5, 29.5, 30.5	9.5, 10.2, 10.4
		(IH ex. 77-84	..	..	..	..)
EL	Burmese subspp ? ? (sp. No. 1130	71	18.5	78	28.5	8.7

1181. *et. al.* **Pomatorhinus erythrogenys** subspp.

		Wing	Bill	Tarsus	Tail
	♂♂				
1181.	*erythrogenys* (8)	97-102 av. 99.6	33-35.5 av. 33.9	32. 0-36 av. 34.2	90-107 av., 99.4
		(IH 95-101	from skull 36-39	36-38	96-108)
1183.	*haringtoni* (14)	92-100 av. 96.4	31.3-38 av. 33.6	32.5-35.5 av.33.5	98-102 av. 94.2
		(IH 92-99	from skull 34-39	36-40	91-103)
1184.	*mcclellandi* (1)	86	29.1	29.5	90
		(IH 86-96	34-37	36-40	91-101)
	♀♀				
1181.	*erythrogenys* (6)	94-101 av. 97.3	30.5-33.3 av. 31.9	31.4-35 av. 33.9	93-100 av. 97
		(IH 90-96	from skull 35-39	36-38	95-99)
1183.	*haringtoni* (5)	90-101 av. 95.4	30.3-34 av. 32.5	31.5-34.5 av. 32.7	87-101 av. 95.2
		(IH 88-93	34-35	35, 36	96 (1))
1184.	*mcclellandi* (3)	90, 86, 82	27.2-27.5, 28.7	29, 31.5, 33.5	82, 85, 88
EL	*odicus* 2 o ?	86, 93	31.8 (2)	33, 32	84, 97

1185. **Pomatorhinus hypoleucos hypoleucos**

1♂ 1 o ?	109, 107	38, —	38.4, 36.5	95, 92
	(IH 1♂ 1♀ 103, 102	from skull 45, 41	41, 41	91, 90 both worn)

1186-1188a. **Pomatorhinus ferruginosus subspp.**

		Wing	Bill	Tarsus	Tail
1186.	*ferruginosus* ♂ (1)	89	28.5	29.1	92
	♀♀ (2)	87 (2)	27, 27.8	29, 30.1	95 (2)
		(IH ♂♀ 87-95	27-28	29-30	99-110)
1187.	*formosus* 1♂ 1♀	100, 89	29.5, 29	32.2, 30.6	97, 85
1188.	*phayrei* 1♀ 1o ?	95, 90	27.5 (2)	30.5, 30.6	105, 92
1188a.	*namdapha* 2♂♂ 1♀	93, 97, 92	30,30.2, 28	32, 34, 29	99, 96, 98

1189-1190. *et. al.* **Pomatorhinus ochraceiceps subspp.**

1189.	*stenorhynchus*	90, 93	35.2, 37	29, 29.5	101,102
	♂♂ (2)	(IH 90, 94	from skull 34, 38	..	..)
EL	nominate	89	32	29.5	101
	ochraceiceps ♂ (1)	(86-92	30-32	about 32	*c.* 105-110)
1190.	*austeni* 1 ♀	91	34	30	105
		(IH ex Mayr 92	from skull 36-37	..	104-107)

1191. **Xiphirhynchus superciliaris supreciliaris**

♂♂ (3)	77, 82, 86	50.5, 52.5	29 (2). 30	81, 88, 92
o ? (2)	78, 87	..	27.5, 28.5	80, 88
	(IH ♂♂ 74-83	from skull 43-57	28-35	82-92)

1193. **Rimator malacoptilus**

♂♂ (3)	56, 57, 58	20.2, 20.7, 21.2	20, 22.6, 23	28 (2), 29

1194. **Napothera brevicauda striata**

1 ♂ 1♀	62, 58	14, 15	21.6, 21	37, 33
	(IH ♂♀ 56-61	*c.* 16	*c.* 24	*c.* 44-46)

1196. **Napothera epilepidota guttaticollis**

2 ♀♀ (1 fledgling)	57, 45	18.5, —	19.2, 17	..
	(♂♀ 50-55	12-13	*c.* 18	*c.* 18)

1197/98. **Pnoepyga albiventer subspp.**

	♂♂				
1197.	*pallidior* (5)	60-62 av. 61.2	12.5-13 av. 12.6	21-22 av. 21.8	14-20 av. 17.2
	white only (3)	60, 61, 61	12.5, 12.6, 13	21, 21.5, 21.8	14, 19, 20

	Wing	Bill	Tarsus	Tail
1198. *albiventer* (9)	58-63 av. 61	11.5-13 av. 12.3	21-23. 6 av. 22.3	..
White only (2)	61, 62	11.7, 13	21, 23.6	..
♀♀				
1197. *pallidior* (1)	59	12	21	..
1198. *albiventer*	59, 62	11.5, 11.5	23, 22.5	..
white only (2)	(IH 1197/8 ♂♀ 57-65	from skull 13-15	23-25	17-23)

1199. Pneoepyga pusilla pusilla

	Wing	Bill	Tarsus	Tail
♂♂ (12)	47-50.5 av. 49	11-15 av. 12.4	16-19.5 av. 17.8	13-17 av. 15
♀♀ (4)	48-51 av. 49.5	11.7-12.6 av. 12.2	16-20 av. 18.1	13, 14, 14
	(IH ♂♀ 48-53	from skull 12-14	18-20	12-15)

1200. Spelaeornis caudatus

	Wing	Bill	Tarsus	Tail
2 ♂♂	45, 45	11.2, 12.2	16.4, 19.4	24, 28
	(IH 45-49	from skull 11-12	18	27-35)

1206. Spelaeornis formosus

	Wing	Bill	Tarsus	Tail
1 ♂	46	*c.* 12	17.2	27
	(IH 46	from skull 14	18	30)

1209. Stachyris rufifrons ambigua

	Wing	Bill	Tarsus	Tail
♂♂ (4) Assam & north	51-54 av. 52.5	12-14.3	15.6-19	43-47
♂♂ (4) Orissa	54-56	13.3-13.7	14.7-19.5	49-51
♀♀ (4)	49, 50, 51, 53	13.2, 11.9, 12.5, 13	17.5, 15.3, 15.5, 16	49, 43 (3)
o ? (1)	51	13	19	43
	(IH ♂♀ 50-56	from skull 13-15	17-22	43-51)

1210. Stachyris ruficeps ruficeps

	Wing	Bill	Tarsus	Tail
♂♂ (4)	58, 57, 56 (2)	15, 12, 13, 14	20.5 (2), 22 (2)	49, 48, 46 (2)
	(IH 53-58	from skull 15-16	17-20	50-52)
♀♀ (2)	56, 52	13, 12.7	17 (2)	44 (2)
	(IH 54	..	..	..)
o ? (3)	57, 56, 55	16, 13.7, 13.3	18, 20.5, 21.6	46, 50, mltg.

1211. **Stachyris pyrrhops**

		Wing	Bill	Tarsus	Tail
	o ? (3)	57, 56, 55	16, 13.7, 13.3	18, 20.5, 21.6	Tail mltg., 46, 50
	♂ (2)	54, 56	13.5, 13.9	18.1, 19.7	49, 51
		(IH 52-56	from skull 15-16	c. 18	48-52)
	♀♀ (5)	51-55 av. 52.7	11.7-12.5 av. 12	15.2-18.6. av. 17	45-50 av. 50.8
		(IH 50-54	from skull 15-16	..	45-51)

1212/13. **Stachyris chrysaea** subspp.

		Wing	Bill	Tarsus	Tail
1212.	nominate				
	(a) 2 ♂♂ 1 o ?	50, 54, 47	11.5, 11.6, 11.2	16.3, 16.6, 15.7	43, 44, 41
	(b) 1 ♂ 3 ♀♀	53, 50, 51 (2)	11.5, 10.8, 11.5, 11.6	18.5, 15, 16.7, 17.9	47, 43 (2), 48
		(IH ♂♀ 47-56	from skull 13-14	17-19	40-50)
1213.	*binghami* 2 ♂♂ 1 ♀	54, 54, 53	13.3, 12.2, 11.8	17.9, 15, 16.2	48, 48, 49
		(IH as in 1212)			

1214/7. **Stachyris nigriceps** subspp.

		Wing	Bill	Tarsus	Tail
	♂♂				
1214.	nominate (6)	57-62 av. 59.6	15.3-17.5 av. 16.6	19-21 av. 20.4	47-53 av. 49.5
		(IH 52-62	from skul 17-19	21-22	50-56)
1217.	*coltarti* (3)	56, 58, 61	16, 16.5, 17.5	21, 21.5, 22	46, 47, 51
		(IH as in 1214)			
	♀♀				
1214.	nominate (3)	56, 60, 60	17, 15.7, 15.5	20.5, 21, 21.5	48, 48, 50
		(IH 56-63	from skull 17-18	21-22	47-51)
1217.	*coltarti* (4)	58, 60 (3)	16.8, 17, 17.1, 18.7	19.5, 19.6, 20.6, 21	48, 51, 52 (2)

1218. **Stachyris oglei**

		Wing	Bill	Tarsus	Tail
	♂ (1)	72	20.6	25.5	58
		(Fauna ♂♀ 68-76	c. 17	c. 27	c. 53)
	♀♀ (3)	70, 71 (2)	18.7, 19.3, 20.6	22.7, 24.5, 25.5	53, 58, 60
		(IH ♀ 63	from skull 20	26	53)

1219/1223. **Dumetia hyperythra** subspp.

		Wing	Bill	Tarsus	Tail
1219.	*abuensis* ♂♂ (4)	56-58	13.5, 14.2,14.3	19.3-20.5	60-65
	abuensis ♀ (1)	56	13.7	17	63
		(IH as in 1221)			
1220.	*navarroi* ♂♂ (12)	53-56 av. 54.9	12.5-14.5 av. 13.5	16.2-19.5 av. 18.3	54-61 av. 58.4
	navarroi ♀♀ (2)	54, 55	13.6, 13.8	18.2, 18.5	57, 59

		Wing	Bill	Tarsus	Tail
1221.	*albogularis* ♂♂ (15)	54-60 av. 57.5	13.5-15.2 av. 14	15.5-20.2 av. 18.9	58-66 av. 63
		(IH 53-65	from skull 14-15	18-20	59-69)
	albogularis ♀♀ (5)	54-59 av. 55.8	12-15.5 av. 13.5	16.1-20.5 av. 18.5	57-67 av. 60
		(IH 52-58	from skull 14-15	18-21	55-69)
	o ? (5)	54-59 av. 57.2	13-15 av. 13.8	16.6-19.6 av. 18.6	49-65 av. 57
1222.	*hyperthyra* ♂♂ (11)	50-57 av. 55	11.3-14.4 av. 13.5	15.3-20.5 av. 18	52-64 av. 59. 7
		(IH 53-58	from skull 13-14	19-21	57-64)
	♀♀ (8)	51-55 - 53.2	12-13.4 av. 12.8	12-20 av. 16.6	48-60 av. 55.6
		(IH 52-55	from skull 13-14	19-20	58-63)
1223.	*phillipsi* 1 o ?	54	13.5	18.6	51
		(IH ♂♀ 54-59	from skull 14-15	19-20	54-63)

1224/7. **Rhopocihla atriceps** subspp.

1224.	*atriceps* (8)	58-62 av. 60	15.3-16.7 av. 16.1	18.2-21.5 av. 20	46-54 av. 49
1225.	*bourdilloni* (1)	56	15.4	21.5	49
	1224/5	(IH 55-61	from skull 14-16	..	46-52)
	♀♀				
1224.	*atriceps* (5)	55-60 av. 58	15.2-16.4 av. 15.6	19.8-21.5 av. 20.6	45-51 av. 48
1225.	*bourdilloni* (4)	56, 57 (2), 60	143, 14.6, 15.1	16.4, 19.5, 21.5, 21.8	45 (3), 46
	1224/5	(IH 54-58	from skull 14-16	21-22	43-48)
1226.	*siccatus* ♂	55 (IH 55-60)	15, (from skull 14-16)	20.7, (21-23)	46 (43-50)
1226.	*siccatus* ♀	53 (IH 54-60)	15 (from skull 14-15)	20.5 (21-23)	45 (42-48)
1227.	*nigrifrons* ♂♂ (3)	57 (2), 58	15.3 (2), 16	20.5, 21, 32	45, 46, 47
		(IH ♂ 59-60	from skull 15	22-23	(44-48)
		(♀ 56, 58)	from skull 15	22-23	44)

♂♂ 1228. *et al.* **Macronous gularis** subspp.

1228.	*rubricapilla* (a) (10)	59-62 av. 60.5	13-16.7 av. 14.5	16-20 av. 17.5	51-57 av. 52.3
1228.	*rubricapilla* (*b*) (6)	57-58 av. 57.5	14-15.5 av. 14.7	15-18.4 av. 16.8	45-50 av. 48
		(IH 55-63	from skull 14-16	17-19	47-57)
EL.	*ticehursti* (5)	56-61 av. 58.6	14.2-15.6 av. 15	16.5-18.2 av. 17.5	47-53 av. 50.6

♀♀ 1228. *et al.* Macronous gularis subspp.

1228.	*rubricapilla* (a) (6)	57-59 av. 58.5	13.5-15.4 av. 14.1	16-20 av. 18.5	49-54 av. 50.8
1228.	*rubricapilla* (*b*) (7)	54-58 av. 56	13.2-15.7 av. 14.4	15-21. av. 17	45-48 av. 46.5
		(IH 52-61	from skull 14-16	18-19	46-55)
EL.	*ticehursti* ♀ (1)	55	14.9	14.5	49

1229. *et al.* Timalia pileata

♀♀	wing	Bill	Tarsus	Tail
bengalensis ♂♂ (5)	61-62 av. 60.6	15.3-17. av. 16.3	21.5-22.5 av. 22	63-66 av. 64
	(IH 58-62	from skull 18-19	23-24	65-71)
bengalensis ♀♀ (4)	57-61 av. 59	15-18 av. 16	21.6-23.5	av. 22.7
	(IH 56-60	15-17	*c.* 22	*c.* 66)
intermedia ♀♀ (2)	61, 65	15.4, 16.5	21,—	71, 72
smithi o ?	58, 62	16.7, 17.6	22.7, 23	—, —

1230/32. Chrysomma sinense subspp.

	♂♂				
1230.	*hypoleucum* (9)	62-70 av. 66.1	12.1-13.7 av. 12.7	22.8-26 av. 24.1	76-95 av. 86.5
	hypoleucum juv. (6)	62-69 av. 65.6	11.5-13.3 av. 12.1	22.8-26.4 av. 24.9	67-97 av. 80.2
		(IH 61-71	from skull 14-15	22-27	80-104)
1231.	*sinense* (a) (7)	63-67 av. 65	11.7-14 av. 13	23-27.1 av. 25.7	60-90 av. 81.2
	sinense (*b*) (9)	64-72 av. 67.5	12.6-14.5 av. 13.5	23.1-26.2 av. 25.1	74-90 av. 80.3
		(IH 62-70	from skull 14-15	22-27	73-102)
1230.	*hypolecum* (9)	64-68 av. 65.5	11.5-13.5 av. 12.2	21.8-26.7 av. 24.2	83-97 av. 88
		(IH 61-67	from skull 13-16	25-27	84-94)
1231.	*sinense* (*a*) (4)	62-70 av. 65.2	12.8-13.7 av. 13.3	25-26.5 av. 25.8	62-83 av. 73.2
	,, (*b*) (4)	(IH 62-70	from skull 13-16	25-27	78-100)
		62-70 av. 66	10.7-14.1 av. 12.5	23-26 av. 24.8	74-87 av. 79.5
1232.	*nasalis* (1)	65	14	24	74
		(IH 63-69	from skull 14	24-25	72-79)

(To be continued)

NEW DESCRIPTIONS

A NEW SPECIES OF THE GENUS *ASOPUS* (HETEROPTERA: PENTATOMIDAE)[1]

M. Nayyar Azim and S. Adam Shafee[2]

(*With a text-figure*)

Asopus rufus sp. nov.

(Fig. 1 A-D)

Head (fig. A): Reddish and finely punctate, vertex with a dark spot on inner margin of each ocellus; juga as long as tylus, lateral margins sinuate before eyes; eyes dark brown; space between ocellus and inner orbital margin more than one-half the inter-ocellar space. Rostrum reddish yellow, extending near hind coxae; segments I, II, III and IV, 1.3, 1.9, 0.79 and 0.46 mm in length respectively. Antennae (fig. 1 B) dark except first segment red; segments I, II, III, IV and V, 0.42, 1.9, 0.98, 1.5 and 1.6 mm in length respectively.

Thorax (fig. 1 A): Reddish and finely punctate with two small triangular spots on anterior area of pronotum and two rounded spots on each basal angle of scutellum dark; pronotum with anterior margin slightly concave, maximum width of pronotum more than twice its median length, humeral angles subacute; scutellum gradually narrowing and acuminate apically, slightly longer than wide; metasternal scent gland ostiole with peritreme moderately long and raised apically. Hemelytra (fig. 1 C) with corium red and finely punctate, membrane infuscated. Legs: coxae, trochanters and femora red; tibiae except outer and inner margins and tarsi dark.

Abdomen: Dorsum and connexiva red, venter whitish except apex dark; venter basally with a small tubercle.

Body length: 11.9 mm.

Holotype ♀. INDIA: Uttar Pradesh, Agra, on grass, 15. xi. 1979 (M. Nayyar Azim)

The new species is closely related to *Asopus malabaricus* (Fabricius) but can be separated by the following characters:

Head (fig. 1 A) reddish with two small dark spots between ocelli: space between ocellus and inner orbital margin more than one-half the inter-ocellar space; antennal segment first red, second less than twice the length of third (fig. 1 B); scutellum (fig. A) gradually narrowing apically; hemelytra (fig. 1 C) with corium completely red; legs with coxae, trochanters and femora, abdominal dorsum and connexiva completely red.

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[1] Accepted March 1981.

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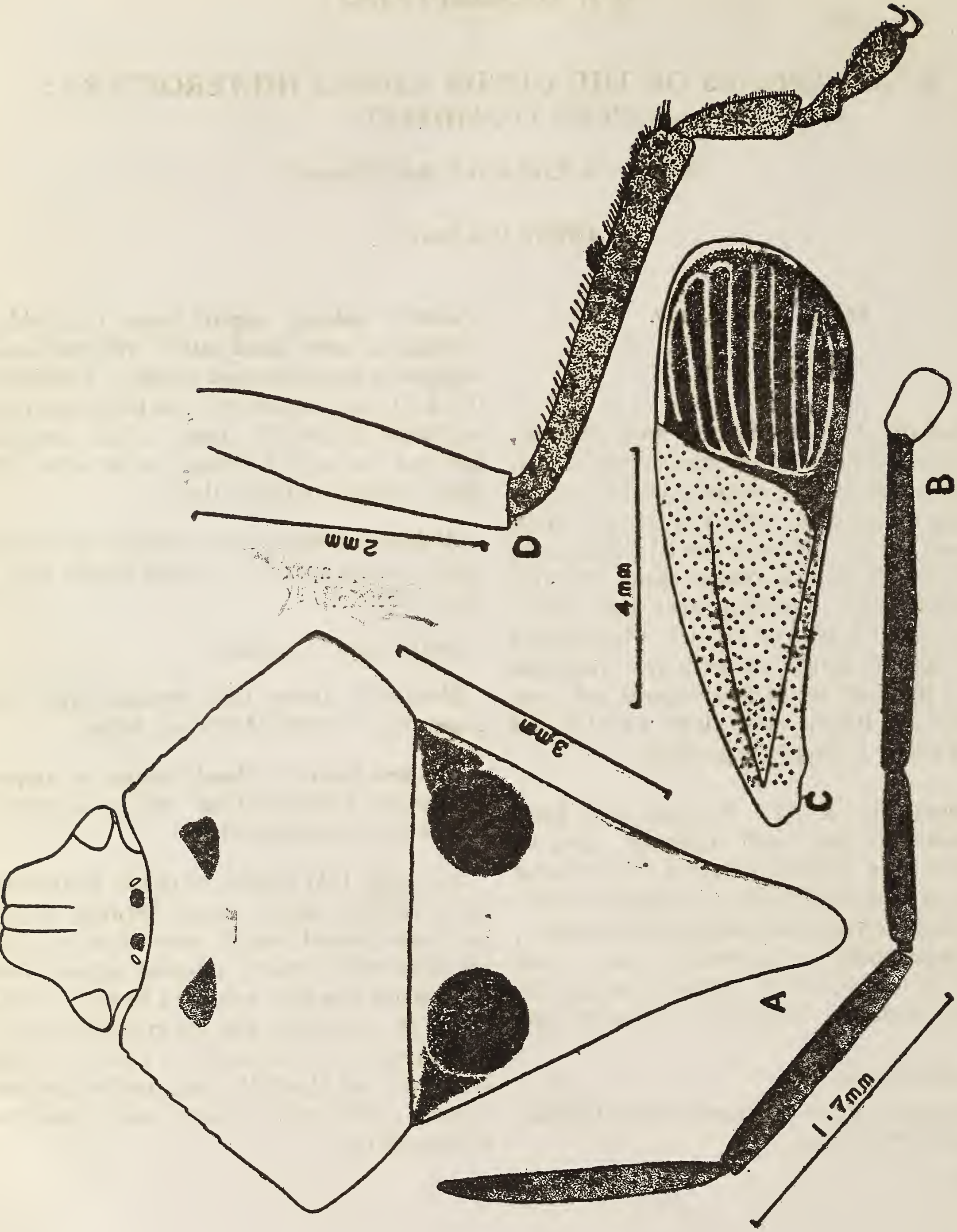
A
B
C
D
3mm
1·7mm
4mm
2mm

Fig. 1 A-D. *Asopus rufus* sp. nov., ♀; (A) Head and thorax in dorsal view ; (B) Antenna ; (C) Hemelytra ; (D) Fore leg.

(See Overleaf)

FIRST RECORD OF GENERA *NIPHADONYX* DALLA TORRE AND *ISCHNOPUS* FST. AND DESCRIPTION OF TWO NEW SPECIES FROM INDIA (COLEOPTERA : CURCULIONIDAE : HYLOBIINAE)[1]

H. R. PAJNI AND SUKESHA SOOD[2]

(*With eleven text-figures*)

INTRODUCTION

We have collected 35 species of the subfamily Hylobiinae under a 5 year PL-480 Project on Indian Curculionidae. Fourteen of the species collected were new to science. Two of these species, one each under genus *Niphadonyx* Dalla Torre and *Ischnopus* Fst. are being reported in this communication.

Previous work on Indian Hylobiinae consists of accounts of individual species by different workers but the characters of Indian genera have been elaborated and keys for them have been proposed by Marshall (1932) and Aslam (1963).

The monobasic genus *Niphadonyx* Dalla Torre was first erected by Faust (1886) as *Heteronyx*, which being preoccupied was replaced by the present name by Dalla Torre *et al.* (1932). The genus was typed on *N. ferus* Fst. from Pamir. The type-species and a new species have been collected and studied by the authors, marking the first report of this genus from India. The elaborated characterization of genus and description of the new species are recorded below. The information on male and female genitalia of the type species of genus *Niphadonyx* Dalla Torre is recorded and key to the species of the genus is also given.

Genus *Niphadonyx* Dalla Torre

Head with frons as broad as or broader than base of rostrum ; eyes lateral, small. Pronotum with basal margin rounded ; prosternum deeply excavated. Elytra truncate at base, without marked shoulders. Mid and hind tibiae broadened subapically, with their fringes sinuate ; tarsal claws appendiculate. Metasternum shorter than diameter of middle coxae. Abdominal sternite 2 shorter than 3 and 4 taken together. Male genitalia with endophallus well developed ; parameres long and leaf-like. Spiculum ventrale laterally produced and medially curved at its free end.

Type Species : *Niphadonyx ferus* (Fst.)

KEY TO SPECIES OF GENUS *Niphadonyx* DALLA TORRE

Small species. Frons without a median fovea. Pronotum closely and deeply punctate. Striae granulate. Aedeagus with apex pointed. . . . . *ferus* (Fst.)

Large species. Frons with a median Fovea. Pronotum closely and rugosely punctate. Striae without granules. Aedagus with apex broad . . . . *foveatus* sp. nov.

Niphadonyx ferus (Fst.)

(Figs. 1, 2, 3)

Faust, Horae Soc. Ent. Ross., XX, 1886, p, 172.

Male genitalia : Aedeagus long, about two times as long as broad, broadest at base and

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gradually narrowed towards apex, subacuminate apically, strongly sclerotized laterally and apically; phallotreme almost circular, with a pair of lightly sclerotized triangular plates one on either side; aedeagal apodemes very long, longer than aedeagus, each slightly curved outwards near base but swollen and weakly sclerotized at free end; endophallus beset with irregularly distributed short tubercles; phallobase uniformly sclerotized, parameres long, leaf like, free at base, with apical membranous part of each furnished with many short setae; phallobasic apodeme as broad as aedeagal apodemes and about one-third as long as the former, with their apical ends rounded.

Female genitalia: Coxites long, subtriangular, weakly sclerotized; styli longer than broad, almost parallel-sided, more sclerotized than coxites, each furnished with a few short and long setae at apex. Spiculum ventrale V-shaped, laterally produced at free end, not uniformly sclerotized. Spermathecal capsule short, slightly curved at middle, uniformly and weakly sclerotized; cornu short with its apex blunt; ramus and collum not distinctly marked.

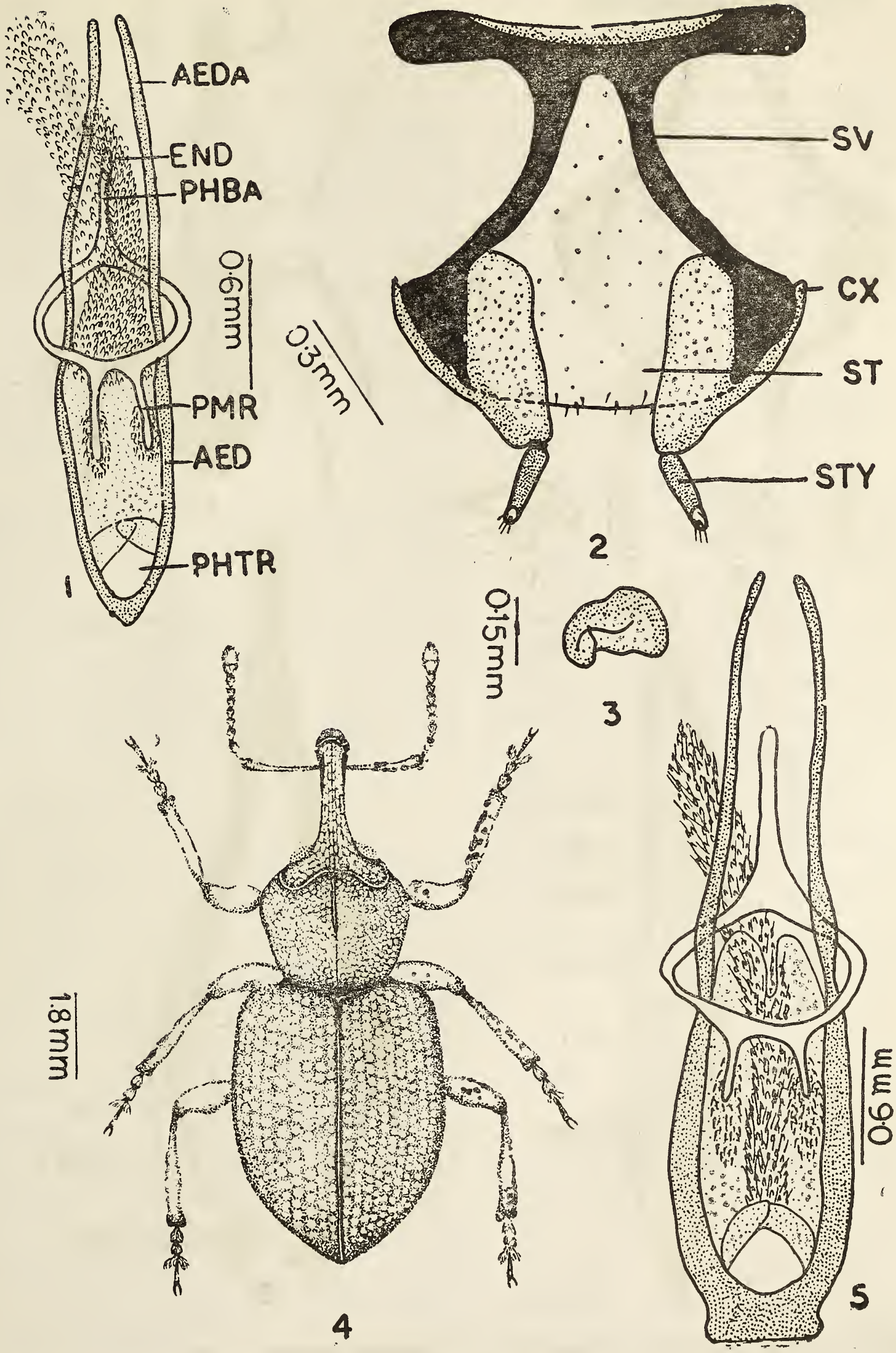
Specimen loaned from Forest Research Institute, Dehradun; reported to be collected under stones in Lidar Valley, State of Jammu and Kashmir.

Niphadonyx foveatus sp. nov.

(Figs. 4, 5, 6, 7)

Head piceous, coarsely and closely punctate; frons broader than base of rostrum, with a median shallow fovea; eyes brownish-black, latero-ventral, acuminate below, separated beneath. Rostrum fuliginous, shorter than pronotum, gradually widened towards apex, with a small shallow median indistinct sulcus near antennal insertion; surface of rostrum coarsely and rugosely punctate, punctures fine and sparse beyond antennal insertions, furnished with very minute pale setae, setae long near apex; scrobes oblique, their apical ends visible dorsally, widely separated beneath. Antennae ferrugineous, long, inserted near apex of rostrum; scape long, slightly longer than funicle, clavate at apex, beset with pale white sparse setae; funicle 7-segmented, beset with long yellow setae, segments 1 and 2 longer than other segments, 3 to 7 transverse, 7 distinct from club; club 2-segmented, pubescent, terminal segment acuminate, with a few sparse thin white setae.

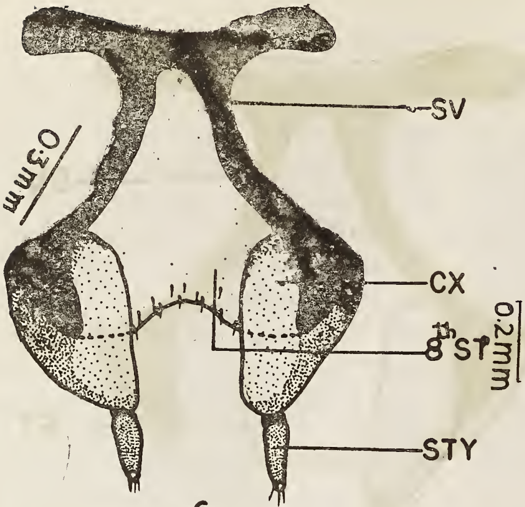
Pronotum piceous, almost as long as broad, narrow at base and broadest at middle, its apical margin bisinuate and basal margin straight; surface of pronotum coarsely and rugosely punctate, marked with a median carina stopping short a little in front of basal margin. Scutellum piceous, small, slightly convex, indistinctly punctate. Elytra piceous, broader at base than base of pronotum, with humeral angles indistinct, their conjoint apices rounded, posterior of each callosity not distinct; surface of each elytron marked with indistinct striae formed of shallow puncture; intervals broader than striae, with a few small scattered pale yellow setae. Legs piceous, sparsely covered with pale white setae; femora edentate ventrally, front femora thicker than middle and hind; tibiae marked with longitudinal ridges, mid and hind tibiae broader subapically and their fringes sinuated; claws appendiculate. Thoracic sternites piceous, punctate, beset with small pale yellow setae; prosternum with its anterior margin deeply sinuate, with a shallow canal present in front of procoxae; metasternum shorter than diameter of middle coxae. Abdominal sternites punctate, beset with small pale yellow setae, intercoxal process between hind coxae broad; sternites 1 and 2 equally long, 2 shorter than 3 and 4 taken together,


AEDA
END
PHBA
0·6mm
PMR
AED
PHTR
1
0·3mm
SV
CX
ST
STY
2
0·15mm
3
1.8mm
4
0·6 mm
5

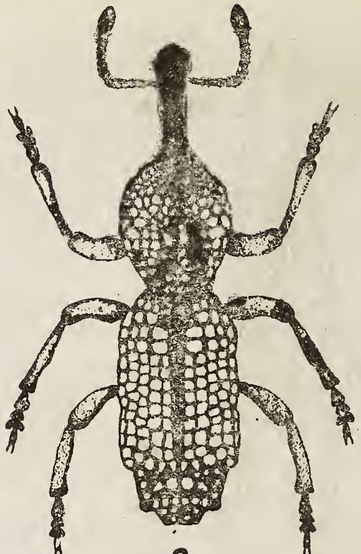
Figs. 1. Male genitalia of *Niphadonyx ferus* (Fst.)
2 & 3. Female genitalia & spermatheca of *Niphadonyx ferus* Fst.
4. Adult *Niphadonyx foveatus* sp. nov. ♂
5. Male genitalia of *Niphadonyx foveatus* sp. nov.

Abbreviations :

AED—Aedeagus; AEDA—Aedeagal apodeme; CX—Coxite; END—Endophallus; PHBA—Phallobasic apodeme; PHTR—Phallotreme; PMR—Paramere; ST—Sternite; STY—Styli; SV—Spiculum Ventrale.


SV
0·3mm
CX
0.2mm
8th ST
STY

6



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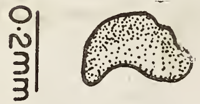

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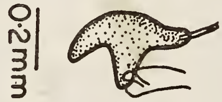

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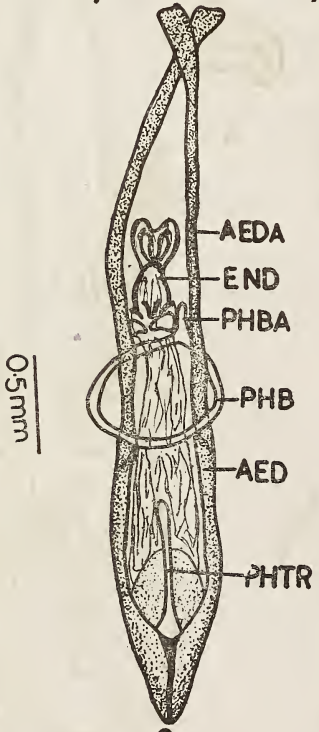
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PHBA
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PHB
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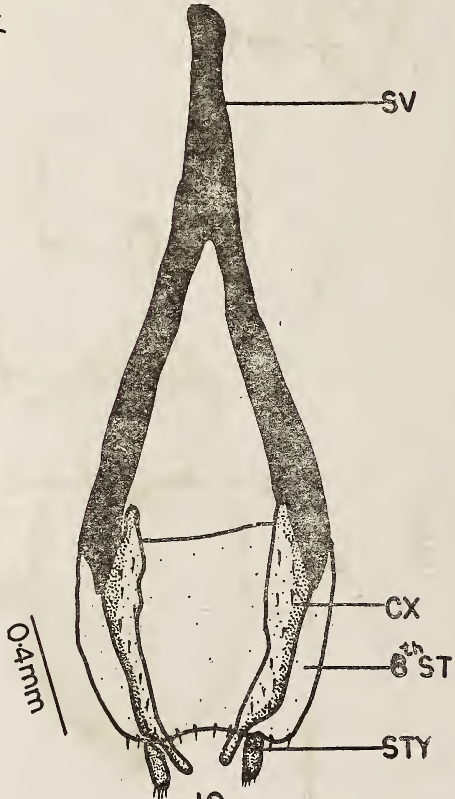
PHTR

9


SV
CX
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8th ST
STY

10

Figs. 6 & 7. Female genitalia and spermatheca of *Niphadonyx foveatus* sp. nov.
8. Adult *Ischnopus madrasensis* sp. nov. ♂
9. Male genitalia of *Ischnopus madrasensis* sp. nov.
10 & 11. Female genitalia & spermatheca of *Ischnopus madrasensis* sp. nov.

Abbreviations :

AED—Aedeagus; AEDA—Aedeagal apodeme; CX—Coxite; END—Endophallus; PHB—Phallobase; PHBA—Phallobasic apodeme; PHTR—Phallotreme; ST—Sternite; STY—Styli; SV—Spiculum Ventrale.

Male genitalia : Aedeagus long and tubular, almost two times as long as broad, with apex truncate, strongly sclerotized laterally and apically ; phallotreme circular, studded with a pair of triangular weakly sclerotized plates ; aedeagal apodemes slightly longer than aedeagus, each slightly curved outwardly at base, broad at base and narrowed to apex ; endophallus beset with dense short setae and tubercles. Phallobase uniformly sclerotized ; parameres long, leaf-like, separated at base, with apical membranous part of each furnished with many short setae ; phallobasic apodeme two-third the length of aedegal apodemes, broad at base and narrowed towards apex.

Female genitalia : Coxites long, oval, weakly sclerotized ; styli longer than broad, almost parallel-sided, more sclerotized than coxites, each with a few setae at apex, spiculum ventrale uniformly sclerotized, V-shaped, laterally produced at free end. Spermathecal capsule uniformly sclerotized ; cornu short and rounded at apex ; collum and ramus not well marked.

Measurements :

Body length	..	12.8-13.2 mm.,
breadth	..	4.6-5.2 mm.
Head length	..	0.8 mm.,
breadth	..	2.0 mm.
Rostrum length	..	2.2 mm.,
breadth	..	0.9-1.0 mm.
Prothorax length	..	3.0 mm.,
breadth	..	3.1-3.2 mm.
Elytra length	..	6.8-7.2 mm.,
breadth	..	4.6-5.2 mm.

Holotype ♂, paratypes 2 ♀♀; India, Jammu and Kashmir, Lidar Valley, Grass (H. R. Pajni) Material in Department of Zoology, Panjab University, Chandigarh.

The monobasic genus *Ischnopus* Fst. is so far represented by a single species from Sri Lanka namely *I. taprobanus* Fst. We have collected another species definitely congeneric with *I. taprobanus* Fst. but differing from it. The new species is thus a new record of genus *Ischnopus* Fst. from India. The revised features of the genus *Ischnopus* Fst., the description of the new species and a key to the two species so far known are recorded below.

Genus *Ischnopus* Fst.

Rostrum with a glabrous epistome. Eyes lateral. Prementum longer and broader than postmentum. Funicle with segment 1 slightly longer than 2, 7 contiguous with club. Prosternum in front of coxae longer than their diameter. Elytra without shoulders. Femora gradually clubbed and unarmed, procoxae subglobular ; tibial premucro small ; tarsi sublinear, third tarsal segment slightly bilobed. Intercoxal process between hind coxae truncate and as broad as hind coxa. Male genitalia without parameres ; endophallus well developed. Female genitalia with coxites very narrow.

Type species *Ischnopus taprobanus* Fst.

KEY TO THE SPECIES OF GENUS *Ischnopus* FST.

Pronotum with a rhomboidal impression ; Prosternum with a pair of tubercles, one near each coxa. Elytron produced in front at the base of interval 4..... ....*taprobanus* Fst.

Pronotum without any impression ; Prosternum without such tubercles. Elytron not produced at the base of interval 4................*madrasensis* sp. nov.

chnopus madrasensis sp. nov.

(Figs. 8, 9, 10, 11)

Head rusty black, its surface smooth, without punctures, finely granular, with a deep furrow along posterior margin of each eye; frons almost as broad as or slightly narrower than base of rostrum, marked with a median depression. Eyes piceous, lateral. Rostrum piceous, shorter than pronotum, slightly broadened near apex; surface of rostrum uneven and coarse, without well defined furrow or carina, covered with rust-coloured pubescence; scrobes almost reaching apex, their anterior ends visible dorsally, separated beneath, their upper margins touching the lower margins of eyes. Antennae rust coloured, long, stout, inserted near apex of rostrum; scape longer than funicle, covered with brown pubescence, clavate at apex; funicle 7-segmented, pubescent and beset with sparse light brown setae, basal two segments longer than broad, segment 2 slightly longer than 1, 3 to 6 transverse, 7 longer than broad and contiguous with club; club small, pubescent, beset with light brown setae, 3-segmented, segment 1 smaller than 2 and 3 taken together, 3 very small and acuminate at apex.

Pronotum piceous, longer than broad, broadest at middle, almost parallel-sided, with a constriction near apex, its apical margin truncate and basal margin almost straight; surface of pronotum uneven and coarse, without a puncture or seta, marked with a distinct median carina and many oblique and transverse ridges. Scutellum concealed. Elytra piceous, longer than broad, their humeral angles indistinctly rounded, with a deep constriction near their jointly rounded apex; surface of each elytron marked with striae formed of broad square punctures; intervals narrower than striae, each furnished with irregular tubercles, with a prominent tubercle on interval 3 near base. Legs piceous, stout, covered with brown pubescence; forecoxae subglobular; femora gradually clavate, without a ventral tooth; tibiae slightly curved at base, inner margin of each with a premucro, each beset with small black projections and with a few brown setae along inner margin; tarsal segments not much spongy, with segment 3 bilobed, claws free. Thoracic sternites piceous, beset with brown pubescence; prosternum with its anterior margin sinuate, much longer in front than diameter of procoxae; metepisterna finely punctate, bare. Abdominal sternites piceous, sternites 1 and 2 irregularly punctured, intercoxal process between hind coxae truncate; sternite 1 and 2 almost equal, 2 longer than 3 and 4 taken together.

Male genitalia: Aedeagus long, tubular, broad at middle and gradually narrowed towards apex, strongly sclerotized laterally; phallotreme long, narrowly triangular; endophallus armed with many chitinized plates forming an irregular structure near apex. Phallobase uniformly sclerotized; parameres absent; phallobasic apodeme very short.

Female genitalia: Coxites very long, much longer than broad, each with free end notched and beset with sparse setae; styli slightly longer than broad, strongly sclerotized, each with a few long setae. Spiculum ventrale Y-shaped, its median arm short, lateral arms narrow. Spermathecal capsule uniformly and weakly sclerotized; cornu short with rounded apex; collum long; ramus present at middle of capsule; with broad rounded end.

Measurements :

Body length	..	15.4-18.4 mm.,
breadth	..	4.2-4.8 mm.
Head length	..	0.8-1.4 mm.,
breadth	..	1.8-2.2 mm.
Rostrum length	..	2.8-3.0 mm.
breadth	..	1.02 mm.

Prothorax length	..	4.2-5.2 mm,
breadth	..	3.6-4.2 mm.
Elytra length	..	7.6-8.8 mm,
breadth	..	4.2-4.8 mm.

Holotype ♂, paratype 1 ♀; India, Tamil Nadu, Madras; on *Cedrela toona* (Sukesha Sood). Material in Department of Zoology, Panjab University, Chandigarh.

ACKNOWLEDGEMENTS

We are grateful to Indian Council of Agricultural Research and United States, Department of Agriculture, for financing a 5 year project on family Curculionidae and for sanctioning funds for the visit of senior author to different European Museums for the study of holotypes/paratypes of Indian Curculionidae.

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SPECIES OF THE GENUS *PEDIOBIUS* WALKER (EULOPHIDAE : ENTEDONTINAE) FROM INDIA[1]

M. Younus Khan and S. Adam Shafee[2]

(*With a plate*)

Additional generic characters of pronotum, sub-genital plate and external female genitalia are suggested for the genus *Pediobius* Walker. Key to Indian species of *Pediobius* is given. *P. imbreus* Walker and *P. longicorpus* sp. nov. are described and illustrated. Material deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Genus *Pediobius* Walker

Pediobius Walker, 1846, *Ann. Mag. Nat. Hist.* 17 : 184.

Type-species : *Entedon imbreus* Walker designated by Ashmead (1904).

The genus *Pediobius* was proposed by Walker (1846). Ashmead (1904) designated *Entedon imbreus* Walker as type species of the genus *Pediobius* Walker. Gahan (1921) synonymized the genera, *Pseudacriasoides* Girault and *Epipleurotropis* Girault with *Pleurotropis* Foerster. Nikol'skaya (1952) recognized *Pediobius* Walker and *Pleurotropis* Foerster as valid genera and separated them on the basis of presence of incomplete and complete parapsidal furrows. Gahan (1932), Ferriere (1953), Askew (1962), Peck (1963) and Bouček (1965) synonymized the genera *Pseudacrias* Girault, *Pleurotropis* Foerster, *Rhopalotus* Foerster, *Eupleurotropis* Girault and *Cluthaira* Cameron respectively with *Pediobius* Walker. Bouček (1965) declared the genus *Microterus* Spinola to be a synonym of *Pediobius* Walker and wrote ' As *Pediobius* is today already a well-established and well-known name, it is taken here as the valid name for the genus and, consequently, *Microterus*, although older than the former name, is dropped into synonymy '. He revised the European species of the genus *Pediobius*. Recently, Kerrich (1973) made a comprehensive study on the South Asiatic and Australian species of the genus *Pediobius*. The generic characters proposed by Peck *et al.* (1964) and Bouček (1965) apply well on the species under study. We suggested some new generic characters which are as follows: Pronotum with antero-lateral arms long and narrow, anterior margin deeply concave, posterior margin convex (Pl. 1, fig. E) ; first valvifers semicircular with basal and apical angles at different levels (Pl. 1, fig. I) ; third valvulae short, movably articulated with second valvifers (Pl. 1, fig. J) ; subgenital plate with anterior margin straight, posterior margin with a triangular notch in middle (Pl. 1, fig. L). 9 species of the genus *Pediobius* are known to occur in India. We raised the total to 10 by describing one new species. A key to Indian species of *Pediobius* is provided mainly based on Kerrich (1973).

Key to Indian Species of *Pediobius* Walker, based on females.

1. Frontovertex with reticulation strong or moderately strong almost throughout and more or less regular..2

—Frontovertex with reticulation not strong or moderately strong, but either fine and regular or in greater part weak to indistinct................. 7

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[1] Accepted August 1980.

[2] Section of Entomology, Department of Zoology, Aligarh Muslim University, Aligarh, India.

2. Basalis bearing hairs, normally two, and cubital hair-row starting immediately beyond it............3

—Basalis bare, and cubital hair-row starting beyond the large speculum postbasale : sculpture of scutum and scutellum uniformly reticulate : scape 6 times as long as wide, first funicle segment twice as long as wide, longer than pedicel : ocelli arranged in obtuse triangle ; first abdominal tergite short, one-fourth the length of abdomen.................. *P. longicorpus* sp. nov.

3. Sculpture of scutellum nearly uniform, either reticulate or striate almost throughout..............4

—Sculpture of scutellum not nearly uniform, partly striate or striate-reticulate and partly reticulate, often partly smooth.................................5

4. Sculpture of scutellum in greatest part and of mesoscutum similar, reticulate almost throughout : petiolar segment a little longer than broad........ ....*P. acantha* (Walker)

—Sculpture of scutellum regularly striate almost throughout, very dissimilar from that of mesoscutum : petiolar segment much broader than long......... .... *P. bethylicidus* Kerrich

5. Head, seen from above, not so broad, less than 2½ times breadth of its median length and frontovertex less than 1½ times : first funicle segment, in side view, about 1½ times as long as broad : scutellum strongly longitudinally striate at sides almost to apex, with reticulation at apex that is rather wide-meshed but much weaker, and may extend forward broadly in mid line or may be evanescent, leaving a shining median band in about basal two thirds : space between notaular pits about as broad as a pit... 6

—Head, seen from above, relatively broad, 2½ to 3 times breadth of its median length and frontovertex usually about 1½ times : first funicle segment, in side view, in well-developed specimens, about 2½ times as long as broad: scutellum longitudinally striate-reticulate, merging to regular reticulation in about apical third, the sculpture of almost uniform strength except that, narrowly in mid line in basal part, it is finer yet very distinct: space between notaular pits very much narrower than a pit.............. ...*P. foveolatus* (Crawford)

6. Antennal funicle 3-segmented and pronotal collar sharply margined as is normal for the genus: mesoscutum having longitudinal striation on sides of mid lobe and on parapsides, its hind margin between the notaular pits raised and strongly emarginate : petiolar segment much broader than long : lower face, as normally in the genus, almost smooth: stibiae not or hardly pale at base and apex.................... *P. elasmi* (Ashmead)

—Antennal funicle 4-segmented : the smooth pronotal collar clearly indicated by a change of sculpture but with no elevated margin : mesoscutum without longitudinal striation, its hind margin between the notaular pits very weakly emarginate : petiolar segment a little longer than broad : lower face very distinctly reticulate except narrowly in mid line : tibiae very distinctly pale at base and apex.................... .... *P. agaristae* (Cameron)

7. Frontovertex at least in greater part, with reticulation fine and regular : pronotal collar having sides strongly, or rather strongly narrowed: cutellum having sculpture more or less uniform, very distinct throughout : basalis bare and cubital hair-row starting beyond the speculum postbasale........................8

—Frontovertex in greater part with reticulation weak and irregular to indistinct : pronotal collar having sides no more than moderately narrowed: scutellum having a median band, percurrent or almost so, with sculpture more or less indistinct, sometimes this median band broad and shining : basalis bearing hairs and cubital hair-row starting immediately beyond it......9

8. Smaller species, of length about 1.3 mm : head, seen from above subglobose, not sharply narrowed behind eyes, with ocelli in a strongly acute triangle, and no fine keel running back from the lateral ocelli, the frontovertex not as broad as its median length: antennae having first funicle segment in side view about quadrate, the second and third very distinctly transverse : pronotal collar having fore and hind margins parallel : mesoscutum having hind margin weakly emarginate, the notaular pits shallow and ill-defined : scutellum finely longitudinally reticulate throughout : parapsite in Mantid Oothecae.......... *P. fraternus* (Motschulsky)

—Larger species : head, seen from above, more transverse, sharply narrowed behind eyes, with ocelli in about a right-angled or slightly acute triangle, and a fine keel running back from the lateral ocelli, the frontovertex at least slightly broader than its median length : antennae having first funicle segment in side view about twice as long as broad, the second and third distinctly longer than broad : pronotal collar wider at sides than in middle, the fore and hind margins not parallel : scutellum strongly longitudinally striate, merging to reticulate behind .... *P. stenochoreus* Kerrich

9. Occipital carina discontinuous, represented only by a short ridge developed behind each laterel ocellus : antennal scape very slender, almost parallel-sided for the greater part of its length, about eight times length of its greatest breadth : third funicle segment about quadrate...................... *P. waterstonii* (Masi)

—Occipital carina continuous, as is normal in the genus : antennal scape slightly rounded below, four times length of its greatest breadth : third funicle segment distinctly broader than long.. *P. imbreus* Walker

Pediobius imbreus Walker

(Plate 1, figs. A-M)

Entedon (*Pediobius*) *imbreus* Walker, 1846, *Ann. Mag. nat. Hist.* 17 : 184. *Pleurotropis detrimentosus* Gahan, 1930, *Proc. U. S. natn. Mus.* 77 : 9. *Pediobius imbreus* Walker; Kerrich, 1970, *Orient. Insects*, 4 : 89.

Female (Redescribed in detail).

Head : Dark with metallic bluish reflections, wider than long in facial view ; frontovertex distinctly wider than long, weakly and finely reticulate ; ocelli brown, arranged in obtuse triangle, lateral ocelli by their own diameters from orbital and occipital margins separately ; occipital carina continuous ; frontal fork with arms obtusely diverging ; eyes silvery ; malar space as long as eye width ; malar sutures absent ; antennae inserted at lower level of eyes ; prominence between antennal sockets one-fifth the width of frons between eyes ; mandibles with two acute teeth (fig. A) ; maxillary and labial palpi each 1-segmented (fig. B).

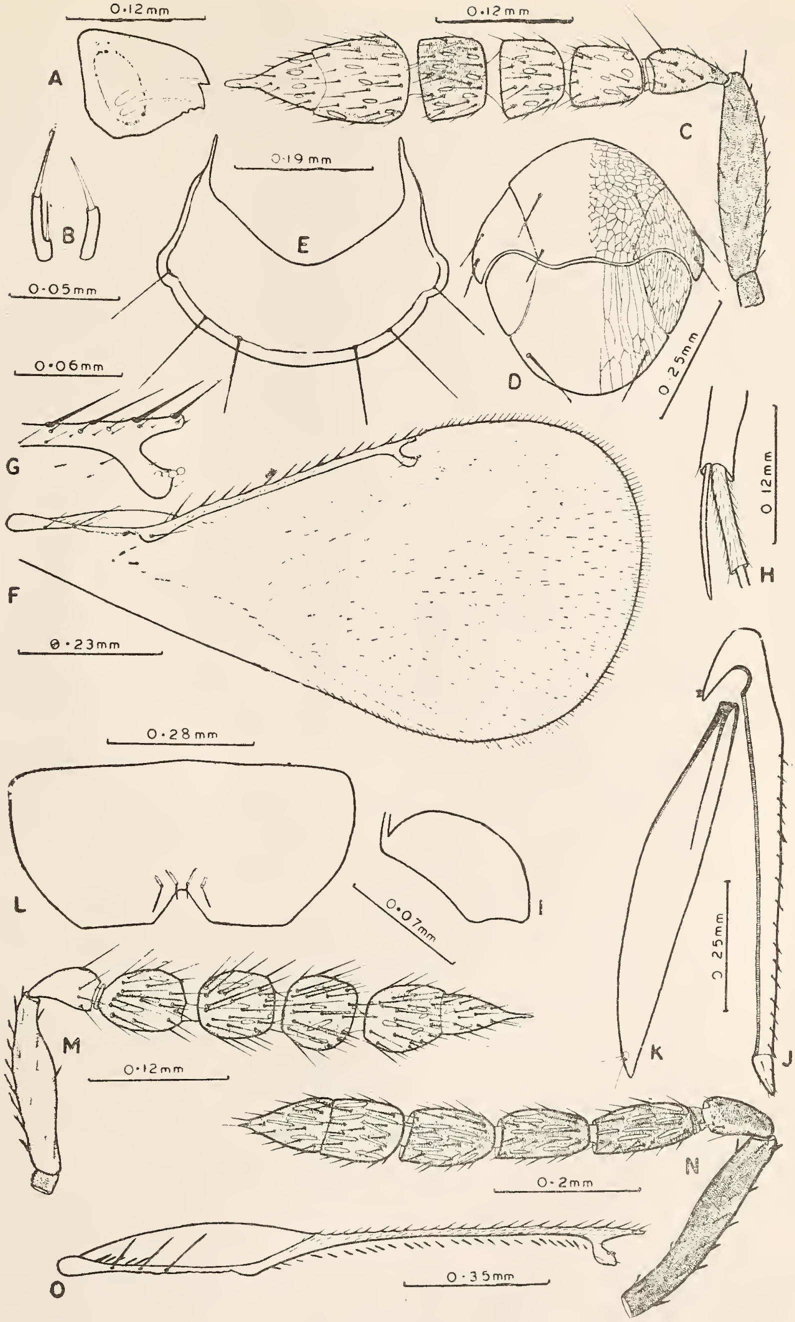
Antennae (fig. C) : Dark with metallic reflections, 7-segmented excluding 1 ring segment ; scape four times as long as wide (0.16 : 0.04 mm), slightly longer than club ; pedicel one and a half times as long as wide, as long as first funicle segment ; funicle 3-segmented, segments 1-3 gradually decreasing in length and increasing in width distad ; first funicle segment distinctly longer than wide, second and third distinctly wider than long ; club 2-segmented, slightly more than twice as long as wide (0.13 : 0.06 mm), longer than preceding two funicle segments together.

Thorax (fig. D) : Dark with metallic bluish green reflections ; parapsidal furrows distinct anteriorly ; pronotum with antero-lateral arms long and narrow, anterior margin deeply concave, posterior margin convex, posterior sub-marginal ridge distinct bearing 3 pairs of long setae (fig. E) ; scutum reticulate and scutellum with longitudinal reticulate sculpture having a median smooth band ; scutum and scutellum with 4 and 2 setae respectively; propodeum with a submedian carina diverging backwards, intercarinal space raised.

Fore wings (fig. F) : Hyaline, twice as long as wide (1.15 : 0.52 mm), sparsely setose, basalis bearing hairs and cubital hair-row starting immediately beyond it ; costal cell much shorter than marginal vein ; submarginal and marginal veins with 2 and 12 setae respectively ; postmarginal vein slightly shorter than stigmal vein (fig. G) ; a row of 14 setae beneath the marginal vein ; marginal fringe short, spaced by a distance equal to one-third their length.

Hind wings : Hyaline, four and a half times as long as wide (0.86 : 0.19 mm) ; marginal fringe short, spaced by a distance equal to one-third their length.

Legs : Coxae, trochanters, femora and tibiae of all legs dark with metallic bluish reflections ; tarsi of fore legs completely and pretarsus of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Figs. A-M: *Pediobius imbreus* Walker ♀, ♂: (A) Mandible, ♀; (B) Maxillary and Labial palpi, ♀; (C) Antenna, ♀; (D) Part of thorax in dorsal view, ♀; (E) Pronotum, ♀; (F) Fore wing, ♀; (G) Part of fore wing venation, ♀; (H) Part of hind leg, ♀; (I) First valvifer, ♀; (J) Second valvifer and third valvula, ♀; (K) Outer plate of ovipositor ♀; (L) Subgenital plate, ♀; (M) Antenna, ♂.

Figs. N & O. *Pediobius longicorpus* sp. nov., ♀; (N) Antenna, (O) Fore wing venation.

mid and hind legs brownish ; tarsal joints 1-3 of mid and hind legs white ; fore legs with two small tibial spurs ; middle tibial spur longer than basitarsus ; hind tibial spur long, slightly longer than basitarsus (fig. H).

Abdomen : Petiolate, dark with metallic bluish reflections, shorter than head and thorax together ; first abdominal tergite well developed, reaching beyond the mid of abdomen ; ovipositor slightly exserted, arising from basal one-half of abdominal venter ; first valvifers semicircular with basal and apical angles at different levels (fig. I) ; second valvifers long and narrow, more or less of uniform width, anterior margin of basal part much curved, U-shaped ; third valvulae twice as long as wide, one-tenth the second valvifers (fig. J) ; outer plates of ovipositor slightly shorter than second valvifers (fig. K) ; subgenital plate of uniform width with anterior margin straight, posterior margin with triangular notch in middle (fig. L).

Female length : 1.58 mm.

Male :

Resembles female except in the following characters :

Pedicel slightly shorter than first funicle segment ; second funicle segment slightly longer than wide ; club as long as preceding two funicle segments together (fig. M) ; fore wings slightly less than twice as long as wide (0.83 : 0.46 mm) ; abdomen much shorter than thorax.

Male length : 0.98 mm.

Material examined : 8 ♀, 1 ♂, INDIA : Rajasthan, Udaipur, ex eggs of Spider, on *Citrus* sp., 2. x. 1975 (*M. Younus Khan*).

Pediobius longicorpus sp. nov.

(Plate 1, figs. N & O)

Female :

Head : Dark with metallic bluish reflections, wider than long in facial view ; frontovertex with reticulation strong throughout and regular, twice as wide as long, width more than one-half the total head width ; ocelli red, arranged in obtuse triangle, lateral ocelli by their own diameters from orbital and close to occipital margins ; eyes silvery and smooth ; malar space slightly shorter than eye width ; malar sutures absent ; antennae inserted at lower level of eyes.

Antennae (fig. N) : Dark brown, 7-segmented excluding 2 ring segments ; scape cylindrical, six times as long as wide (0.3 : 0.05 mm), longer than club ; pedicel one and a half times as long as wide, shorter than first funicle segment ; funicle 3-segmented ; first funicle segment twice as long as wide, longer than following segments separately ; segments second and third subequal in length, each one and a half times as long as wide ; club 2-segmented, two and a half times as long as wide (0.19 : 0.07 mm), shorter than preceding two funicle segments together.

Thorax : Dark with metallic bluish reflections and reticulately sculptured ; parapsidal furrows distinct anteriorly by depressions ; sculpture of scutum and scutellum uniformly reticulate, similar and with 6 and 2 setae respectively ; propodeum with median carina diverging posteriorly.

Fore wings : Hyaline, twice as long as wide (1.85 : 0.92 mm) ; costal cell broad, shorter than marginal vein ; basalis bare, cubital hair-row starting beyond the large speculum postbasale ; submarginal and marginal veins with 3 and 21 setae respectively (fig. O) ; marginal fringe short, spaced by a distance equal to one-third their length.

Hind wings : Hyaline, four times as long as wide ; marginal fringe short, spaced by a distance equal to one-third their length.

Fore legs : Dark except mid-longitudinal area of tibiae and basal three tarsal segments white.

Middle legs : Dark except apex of femora, base and apical half of tibiae and basal three tarsal segments white.

Hind legs: Coloration same as middle legs.

Abdomen : Brownish, with purplish reflections, longer than head and thorax together ; first abdominal tergite short, one-fourth the abdominal length ; ovipositor slightly exserted, arising from base of abdominal venter.

Female length : 2.5 mm.

Holotype : ♀. INDIA : Uttar Pradesh, Aligarh University Campus, ex Dipterous pupae, 10. ix. 1977 (*M. Younus Khan*).

ACKNOWLEDGEMENTS

We are deeply indebted to Prof. S. Mashhood Alam, Head, Department of Zoology, for providing research facilities. Thanks are also due to Prof. Nawab H. Khan for encouragement.

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A NEW SPECIES OF *TETRASTICHUS* HALIDAY 1843 (HYMENOPTERA : EULOPHIDAE) FROM HIGH ALTITUDE OF INDIA[1]

M. A. Khan[2]

(*With thirteen text-figures*)

Genus *Tetrastichus* Haliday 1843

Genotype: *Cirrospilus attatus* Walker, by original designation [*miser* (Nees)].

Tetrastichus Haliday, 1843, Trans. Ent. Soc. London, Vol. 3, p. 297-298 (Type, *Cirrospilus attatus* Walker).

Tetrastichus Kurdjumov, 1913, Russ. Ent. Obozr (Rev. Russe Ent.). Vol. 13, p. 253, (Type, *Cirrospilus attatus* Walker).

Tetrastichus Gahan, 1914, Proc. U.S. Nat. Mus., Vol. 48, p. 166, (Type, *Cirrospilus attatus* Walker).

Tetrastichus Haliday is one of the most easily recognizable genus of the family Eulophidae. The genus has been revised by Burks (1943) proposing stable generic characters. In addition, some new generic characters have also been proposed, which will further facilitate the identification of this genus, *viz.* (i) sub-genital plate with anterior margin concave in the middle, the central notch of its posterior margin with laterally directed ridges (ii) first valvifers semicircular, (iii) third valvulae moderate size, movably articulated with second valvifers, and (iv) outerplates of ovipositor with a ridge along basal half of dorsal margin and another ridge starting at base of dorsal margin and running obliquely upto middle of plate.

Tetrastichus atomelli sp. nov. (Figs. 1-13)

Female :

Head yellowish with some infuscation on face, antennae light brown with scape yellowish ; thorax golden yellow with dark brown patches on greater part of pronotum and on anterior part of scutum, margins of scutum and scutellum blackish brown ; propodeum dark brown with golden reflections ; legs yellowish with some parts infuscated ; abdomen light brown with golden reflections on dorsum.

Head : (Fig. 1) : Yellowish with some infuscation on face, wider than long in frontal aspect (0.4 : 0.31), width of frons (0.24) between eyes slightly more than one half of head width, frontovertex wider than long (0.3 : 0.18), ocelli red, arranged in obtuse angle triangle, basal ocelli removed from eye rim by three diameter of an ocellus and from occipital margin by one ocellar diameter, eyes red, short, bare ; malar space longer than the transverse diameter of eye ; antennae inserted nearly in centre of frons, antennal sockets two times as high as wide, separated by three times the diameter of a socket, distance between antennal sockets and eye slightly more than the distance between two antennal sockets, subocular suture distinct, mandibles tridentate with red apices (Fig. 2), maxillary (Fig. 3) and labial palpi (Fig. 4) each one segmented.

Antennae (Fig. 5) : Light brownish with scape yellowish, setose ; scape slightly flattened, more than three times longer than wide (0.22 : 0.07) ;

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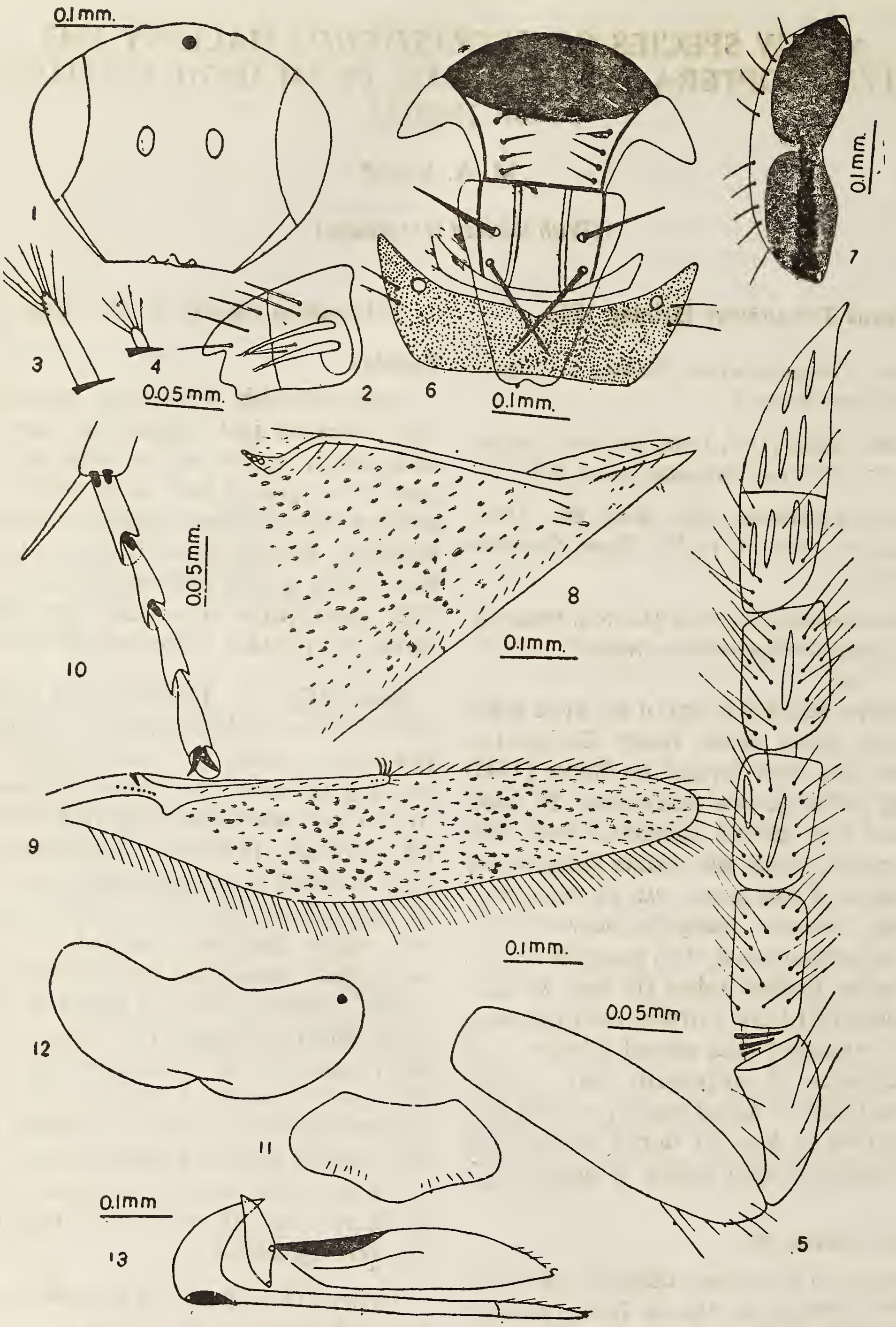
[1] Accepted August 1981.

[2] Department of Entomology, College of Agriculture, G. B. Pant University of Agri. & Tech., Pantnagar, Nainital, U. P., India. Research paper No. 2280 through the Experiment Station, G.B.P.U. A. & T.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Figs. 1-13. *Tetrastichus atomelli* sp. nov. ♀ 1. Head facial view; 2. Mandible; 3. Maxillary palp; 4. Labial palp; 5. Antenna; 6. Thorax, dorsal aspect; 7. Pronotum; 8. Part of fore wing; 9. Hind wing; 10. Part of middle leg; 11. Eight tergum; 12. Subgenital plate; 13. Ovipositor.

pedicel long more than twice as long as wide (0.11 : 0.05), distinctly longer than first funicle segment, funicle with three ring segments, funicle segments longer than wide, first and second funicle segments subequal in size (0.08 : 0.05), 3rd funicle segment slightly larger in size (0.09 : 0.055) ; club two segmented, more than three times longer than wide (0.17 : 0.055) longer than preceeding two funicle segments combined.

Thorax : (Fig. 6) : Golden yellow with dark brown patches on greater part of pronotum and on anterior part of scutum, margins of scutum and scutellum blackish brown ; propodeum dark brown with golden reflections ; posterior margin of the pronotum (Fig. 7) with ten strong setae ; scutum wider than long (0.27 : 0.15) with six pairs of adnotaular bristles ; scutellum (0.21 : 0.13) shorter than scutum, with two longitudinal dorsal grooves, two pair of scutellar bristles present ; metanotum narrow, band like, propodeum with reticulate sculpture, mesal length of propodeum distinctly less than one third as long as scutum, propodael spiracles contiguous with anterior margin ; mesopostphragma notched in the middle and extended beyond the expanded portion of the propodeum.

Fore wings (Fig. 8) : Hyaline, more than twice as long as wide ; costal cell narrow with six setae ; submarginal vein with five strong setae ; postmarginal vein absent ; stigmal vein less than 1/3 as long as marginal vein ; marginal fringe long, spaced by a distance equal to almost one-fourth length of a fringe.

Hind wings (Fig. 9) : Hyaline, more than five times longer than wide, submarginal vein with one strong setae ; marginal vein with three curved hooklets, marginal fringes long, spaced by a distance almost one-sixth length of a fringe.

Fore legs : Yellowish except basal half of coxae, second and third tarsal segments infuscated ; coxae with a cluster of setae on outer face of basal half and four long, strong setae on outer rim on distal half, femora compressed.

Middle legs : Uniformly yellowish with coxae, trochanter, dorsal margin of femora and last tarsal segment infuscated ; outer rim on distal half of the coxae with two strong setae ; tibial spur longer than basitarsus (Fig. 10), apical rim of tibiae, basitarsus and second tarsal segment with 2, 1 and 1 leg respectively.

Hind legs : Yellowish except coxae, trochanter, basal half of femora and last tarsal segment brownish ; tibial spur shorter than basitarsus.

Abdomen : Light brownish with golden reflections on the dorsum, surface smooth, longer than thorax, eighth tergite as shown in Fig. 11; subgenital plate (Fig. 12) with anterior margin concave in the middle, central notch of its posterior margin with laterally directed ridges ; first valvifers (Fig. 13) semicircular with articular knobs prominent ; second valvifers long (Fig. 13) dorsal margin sightly thickened ; third valvulae (Fig. 13) moderate size, movably articulated with second valvifers ; outer plates of ovipositor (Fig. 13) with a ridge along basal half of dorsal margin and another oblique ridge starting at the base of dorsal margin and running obliquely upto middle of plate ; ovipositor slightly exserted.

Length of female : 1.15 mm.

Male :

Not known.

Holotype : ♀ India, U.P., Garhwal Hills—Joshimath (2895 m), ex. *Tropicomyza atomella* (Malloch) Diptera : Agromyzidae on *Capsicum annuum* L. (M. A. Khan), Hym. Eulo. Typ. Nr. 1001.

Paratype : 1 ♀, same data as holotype, Hym. ulo. Typ. Nr. 1002.

This species is more closely related to *Tetrastichus oklahoma* (Girault) Burks, but differs from it in the following key characters :

(1) Body black to dark brown with some parts white or light yellow ; scape slightly exceeding level of vertex ; post ocellar and ocello-ocular lines equal in length, first funicle segment one and one-fifth times as long as second ; club one and one-fifth times as long as second segment ; length of malar space five eighths height of compound eye ; scutum bearing one and a partial second two of bristle at each lateral margin ; stigmal vein one fourth as long as marginal vein. *T. oklahoma* (Girault) Burks.

(2) Body yellowish with some brown patches or infuscation, compound eyes and ocelli bright red ; apex of scape much below the level of vertex; ocello-ocular line slightly shorter than postocellar line ; first and second funicle segment subequal in length ; club longer than preceding two funicle segments combined; malar space almost one half of the height of compound eyes ; scutum with a row of bristle at each lateral margin ; stigmal vein less than one third as long as marginal vein.....................................*T. atomelli* sp. nov.

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A NEW SPECIES OF *OPHIORRHIZA* L. (RUBIACEAE) FROM NAGALAND, INDIA[1]

D. B. DEB AND D. C. MONDAL[2]

(*With a text-figure*)

INTRODUCTION

In course of taxonomic study of the genus *Ophiorrhiza* L. (Rubiaceae) in Indian subcontinent several gatherings appeared to be new. The present paper is based on such a collection from Naga Hill by the late Dr. N. L. Bor made on two occasions from nearby localities and distributed to the Forest Research Institute, Dehra Dun (DD) and the Royal Botanic Gardens, Kew (K). C.E.C. Fischer examined the material and considered it as an undescribed species, and wished to have more material. Probably the absence of fruit which is very characteristic of this genus for distinction from allied genera made him hesitate in describing it. No further material has been collected since then. But several immature fruits could be located in the specimens which are sufficiently characteristic to confirm the generic status. Hence this species is described and dedicated to the collector, the late Dr. N. L. Bor.

Ophiorrhiza borii sp. nov. (Fig. 1)

ex affinitate *O. tingens* C. B. Clarke ex Fischer et *O. treutleri* Hook. f., ab utroque stipulis subulatis paniculis cymarum helicoidearum terminalibus, corollaque extus pubescenti.

The species is allied to *Ophiorrhiza tingens* C. B. Clarke ex Fischer and *O. treutleri* Hook. f. differing from both in subulate stipules, terminal panicle of helicoid cymes and corolla pubescent outside.

Herbs small; stem erect, unbranched, ridged, puberulous, internodes 1-3.5 cm long. Leaves opposite, decussate, simple, unequally paired, petiolate ; lamina 3-8 × 2-4 cm, ovate or ovate-elliptic, acute, subacuminate or obtuse at the apex, entire, acute or attenuated at the base, puberulous above and on the nerves beneath ; nerves 8-10 on either side, subopposite ; petioles 0.5-1 cm long, puberulous ; stipules subulate with a very broad base, sometimes bifid dividing almost to the base, 3-8 mm long, puberulous. Inflorescence terminal panicle of helicoid cymes, 2-3.5 cm across, puberulous ; peduncles 1-2.2 cm long, puberulous. Flowers bracteate, bracteolate, pedicellate, 6-8 mm long, tubular, pink or white tinged with pink ; pedicels 0.5-1.25 mm long, puberulous ; bracts 1.5-5.5 mm long, linear, puberulous ; bracteoles 1-1.5 mm long, linear puberulous. Hypanthium 1-1.25 mm × 1.2-1.5 mm, obovoid, puberulous. Calyx lobes 5, ovate-lanceolate, 0.5-0.8 mm × 0.25-0.5 mm, obtuse, puberulous. Corolla 5-6.75 mm long, tube 3.75-5.5 mm long, slightly swollen at the base, ribbed, pubescent outside, villous below the throat within ; lobes 5, lanceolate, 1-1.5 mm × 0.6-0.75 mm, acute at the apex, inwardly curved, strongly keeled at the back. Stamens 5, epipetalous, adnate to the corolla-tube below the middle, inserted ; filaments 0.3-0.5 mm long ; anthers 1.2-1.5 mm long, linear

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[1] Accepted December 1981.

[2] Indian Botanic Garden, Howrah, India.

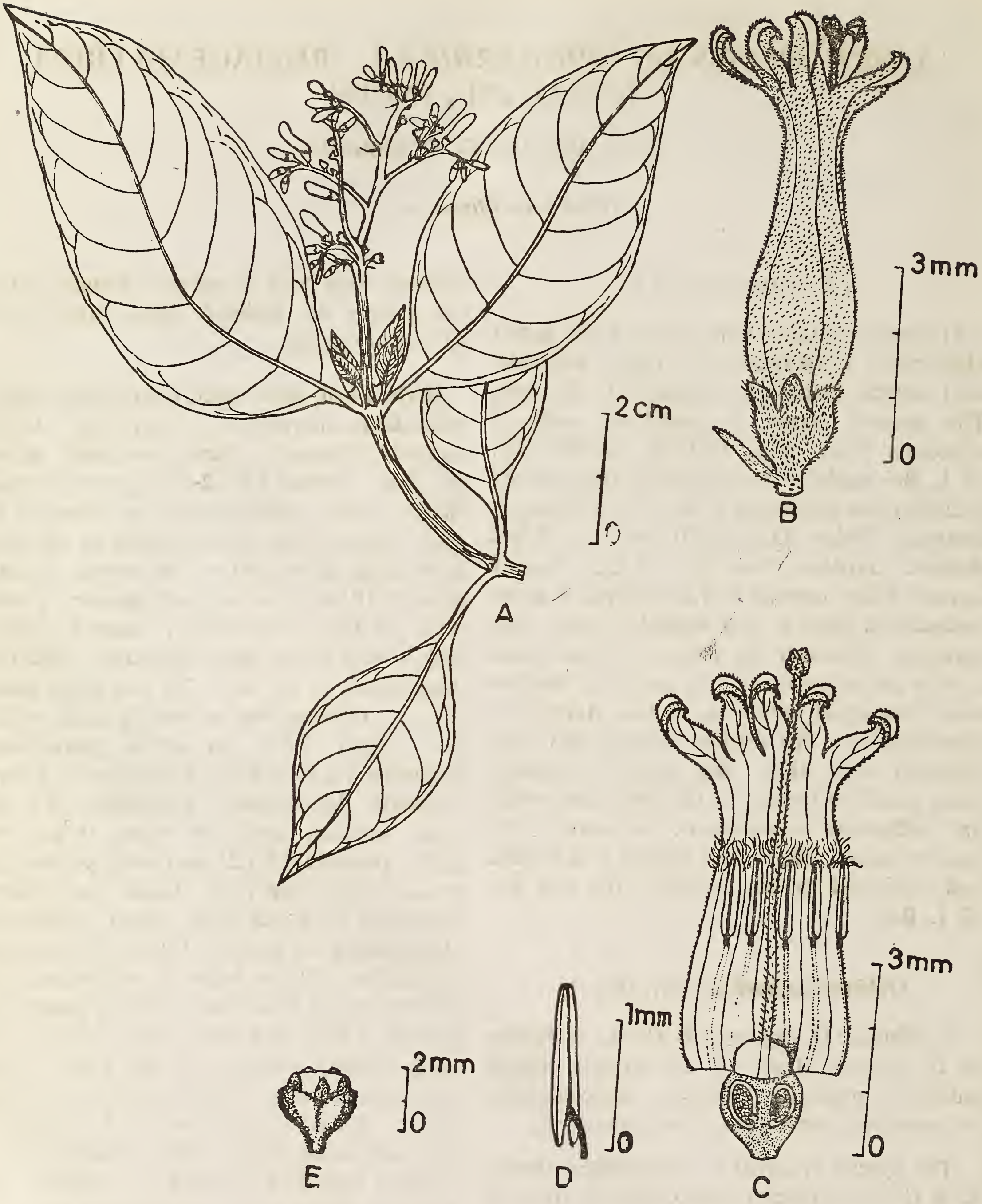
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Fig. 1. *Ophiorrhiza borii* sp. nov. A. habit; B. flower; C. flower split open; D. stamen; E. fruit (immature).

2-lobed, 4-celled, dorsifixed, introrse, dehiscing longitudinally. Pollen grains oblate-spheroidal, semilobate in polar outline, polar axis (P)× equatorial axis (E)$=30\ \mu-(31\mu)\text{-}33\ \mu\times32\ \mu-(34\mu)\text{-}37\mu$, 3-colporate ; colpi $29\mu\text{-}32\mu\times6\mu-6.5\mu$, tapering to obtuse ends ; ora circular, $6\mu\text{-}7\mu$ in diameter, distributed at the equatorial zone ; exine 1.75μ in thickness, sexine 1.5μ, nexine 0.25μ, rugulo-reticulate ; lumina $0.75\mu-1\mu$, muri $0.5\mu-0.75\mu$. Ovary 1-1.2×1.2-1.4 mm, 2-loculed, with many ovules on axile placenta ; disk 0.5-0.7 mm high, 0.6-1 mm wide, fleshy, 2-lobed ; style as long as corolla, pubescent ; stigma capitate, bifid, 0.3-0.4 mm×0.2-0.3 mm, papillate exserted. Capsules (immatured) obcordate, compressed, puberulous, internally 2-loculed.

Flowering time : June.

Occurrence : Nagaland : Naga Hill, Zulhami and Thekubama at an altitude of about 1800 m.

TYPE : *India* : Nagaland, Naga Hill, Zulhami, about 1800 m, 24-6-1935, *N.L. Bor* 4471 (holotype DD ; isotype K) ; Naga Hill, Thekubama, about 1800 m, 19th June 1935, *N. L. Bor* 4465 (paratypes DD, K).

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TWO MORE NEW SPECIES OF *IMPATIENS* L. FROM SOUTH INDIA[1]

V. Bhaskar[2] and B. A. Razi[3]

(*With a plate*)

Impatiens L. (Balsaminaceae) has its greatest development in the Indian region and is remarkably local and has maximum amplitude in two well defined regions, namely the Himalaya in the North and the Western Ghats in the South. There is no doubt in respect of *Impatiens*, the Western Ghats are the second richest area in the subcontinent and perhaps in the world. The genus contains over 200 species in India, of which 86 species occur in South India as reported earlier by Hooker (1904), Gamble (1915), Blatter (1933), Fischer (1936), and Barnes (1939). Among them, at least 90 per cent of the species are restricted to hills of South India. The most important centre of speciation of this genus being in South India (Bhaskar 1981), the species of *Impatiens* have an individuality separate from those recorded from the north or elsewhere. Two of the sections *viz.*, ' Scapigerae ' and ' Epiphyticae ' are exclusively confined to peninsular India. A new ' Epiphyticae ' species *I. urceolata* Bhaskar has been already recorded as a new species from South India (Bhaskar and Grey-Wilson, in press). Endemisim in *Impatiens* has also been reflected in their pollen characters and a 'pollen variety ' of *I. acaulis* has been reported (Bhaskar *et al.* 1975). During the study on the South Indian *Impatiens* two more balsams have been found to be new to science and are described in this paper.

Section : ' Scapigerae '

Impatiens agumbeana sp. nov.

Differt a *I. stocksii* et *I. lawsonii* calcari cylindraceo distincto ad 4 mm longo includenti distinctaque ' auricula dorsali' 3-4 mm longa ; lobo distali alae leviter lobato ; alis libere-dichotome venosis.

Differs from its near relatives *I. stocksii* and *I. lawsonii* in having a distinct cylindrical spur, about 4 mm long, enclosing a distinct ' dorsal auricle ' 3-4 mm long, and a slightly lobed distal lobe of wing, wings with open dichotomous venation.

Epiphytic scapigerous perennial herb, *c.* 10 cm tall, tuberous ; leaves 2-5, radical ; petiole 3-4 cm long, filiform ; lamina 1.5-1 cm, ovate, obtuse, base acute, margins faintly crenate, crenatures minutely apiculate, pubescent above ; flowers in erect scapes, pinkish ; scape *c.* 10 cm long, slender ; bracts linear or ovate ; pedicels filiform, *c.* 1 cm long, glab-

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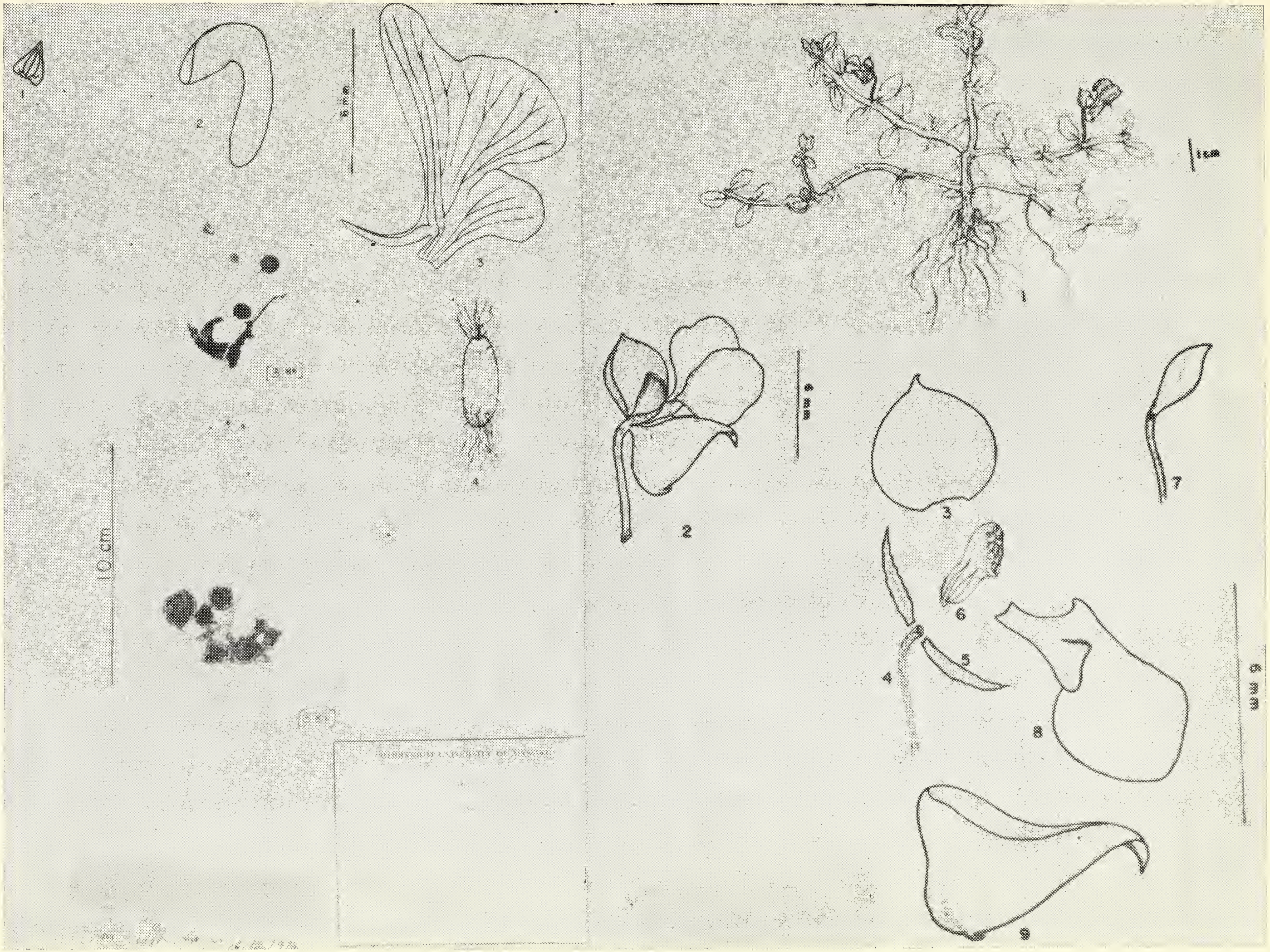
1
2
6 mm
3
4
3 mm
10 cm
1 cm
1
2
6 mm
3
7
6
5
4
8
6 mm
9

Left : *I. agumbeana* sp. nov. : 1. Sepal ; 2. Lip with spur ; 3. Wing petal with dorsal auricle ; 4. Seed with hairs.

Right : *I. raziana* sp.nov.: 1. The plant; 2. a flower ; 3.Standard ; 4. Pubescent pedicel : 5. Linear sepals ; 6. Sex organs ; 7. Fruit ; 8. Wing petal ; 9. Lip with a rudimentary spur.

rous ; sepals ovate, acute, base slightly cordate, 3-nerved, lateral nerves with a short upcurved vein not reaching the apex, margins entire; lip flat, spathulate, 4 mm long ; spur straight, 5 mm long, slightly curved, obtuse, cylindrical ; standard orbicular ; wings 11 mm long, 3 lobed, distal lobes more or less confluent, proximal lobe distinct and smaller ; dorsal auricle prominent, *c.* 4 mm long, venation open dichotomous ; capsules ovoid, many seeded ; seeds oblong, brownish, hairy, hairs dense and elongated at either ends of seeds, spirally banded.

The species is named after the place of its collection. It is a rare epiphytic species occurring on huge tree trunks with moss and hygroscopic ferns in sholas. In *I. stocksii* and *I. lawsonii* which are the near relatives of *I. agumbeana* wings have reticulate venation while in the presently described taxon wings have open-dichotomous venation. There is also difference in the chromosome number in all the three species. In *I. agumbeana* n=8, whereas in *I. stocksii* and *I. lawsonii* n=7 and n=10 respectively.

TYPE : *Bhaskar* 386, Agumbe, Shimoga Dist. (Karnataka), 29-9-1973 : Isotypes have been deposited in the Herbarium, Manasagangotri, Mysore University (MGM), Fls. and frts : July-September.

Section : ' Annuae '

Impatiens raziana sp. nov.

Proxime affinis ad speciem collectivam *I. oppositifoliam-I. chinensem-I. rivulicolam*, tamen differt habitu prostrato, caule quadrangulato, floribus scarlatinis, labello cum calcaro minuto vel rudimentario parum labelli basi exoriente.

Closely related to species complex of *I. oppositifolia—I. chinensis—I. rivulicola*, but differs in having scarlet flowers, prostrate habit with quadrangular stem ; lip with very minute or rudimentary spur arising slightly above the base of lip.

Annual herbs, prostrate or procumbent, 6 cm long, rooting at nodes, roots fibrous ; branchlets arising from basal nodes, opposite, 7-8 cm long ; stems quadrangular, glabrous, herbaceous ; leaves opposite, ovate or spathulate, 4×7 mm, base attenuate, exstipulate, petiolate, apex obtuse, glabrous ; flowers solitary, axillary, scarlet, erect ; pedicels 7 mm long, very finely pubescent ; sepals linear, elliptic, faintly serrulate, veins 3, median distinct, furunculate, furuncles parallel ; lip with a very minute spur, arising slightly above the base of lip, lip yellow-tinged, acute ; standard ovate, more or less mucronate, glabrous ; wings ovate, 2-lobed, smaller lobe fin-shaped, transparent, honey guides prominent ; filaments subulate, unequal ; carpels ovoid, 2 mm long ; capsules glabrous, 3-5 mm long, 2-4 seeded ; seeds shiny, black, smooth, globose.

A rare scarlet balsam, which occurs on grassy plains near Kotegehar, associated with Justicias, Borrerias and grasses. The species very closely resembles Lindernias from a distance and escapes notice. Its pollen mass is scarlet in colour. The species is named after Prof. B. A. Razi, former professor of Botany, Mysore University.

TYPE : *Bhaskar* 311, Kotegehar, Charmad Ghat (Chickmaglore Dist.), Karnataka, 26-8-1972. Isotypes have been deposited in the Herbarium, Manasagangotri, Mysore University (MGM). Fls. and frts. : August-September.

ACKNOWLEDGEMENTS

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A NEW *PTERIS* FROM SILENT VALLEY, KERALA[1]

S. R. Ghosh and R. K. Ghosh[2]

(*With three text-figures*)

During an expedition to Silent Valley, Palghat District, Kerala organised by the Botanical Survey of India in the month of April-May, 1980, the junior author collected some interesting specimens of *Pteris* new to science. The species was found in association with *Bolbitis* and *Egenolfia* growing on rocky slopes in the evergreen, dense forest of Silent Valley where sunlight does not penetrate. The species was confined to such areas only.

The new species is closely related to *P. cretica* Linn. whose occurrence in South India was doubted (Nair & Ghosh 1970) but differs from it in having the margin of sterile frond entire and fewer number of pinnae. It also differs from *Pteris multiaurita* Ag. in having simple forked veins and creeping rhizome.

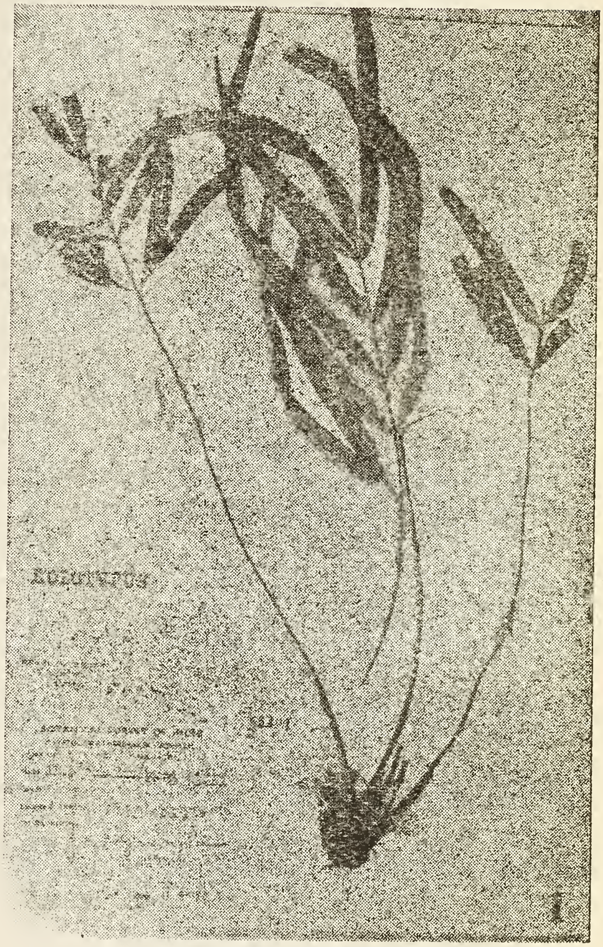

Fig. 1. Photograph of *Pteris silent-valliensis* sp. nov.

Pteris silent-valliensis sp. nov.

P. cretica L. affinis, a qua differt fronde sterili ad marginem, integra, pinnisque paucioribus. A *Pteris multiaurita* Ag., veins simplicibus furcatis, rhizomate repenti differt

Rhizome erectum, squamatum; frondes caespitosae, dimorphae, simplicitor pinnatae, 25-60 cm. longae, frons fertilis fronde sterili majore, stipes purpureus, ad basin niger, triangularis, sulcatus, laevis, glaber, nitens, filo metallico similis, rhachidi multo longior, plerumque maximus in fronde fertile. Stipes frondium sterilium 12-20 cm, longus, hic frondium fertilium 15-45 cm longus. Pinnae laterrales in paribus 2-8 oppositis, pinnae terminales illis lateralibus similes, non decurrentes, unum par inferius vel duo paria inferionce bipartita, Pinnae 10-20 cm longae, 5-12 mm latae, glabrae, nitidae, virides, coriaceae, petiolatae, pinnae steriles majores latioresque, ad marginem integrae, ad opicum

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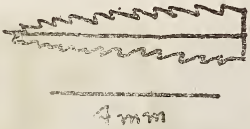
denticulatae, vanae semel furcatae, patentes, prominentes, Rachis nuda, laevis, veridula. Sorus continuus secus marginem, indusium membranaceus, sporae brunneae, tetrahedrales.



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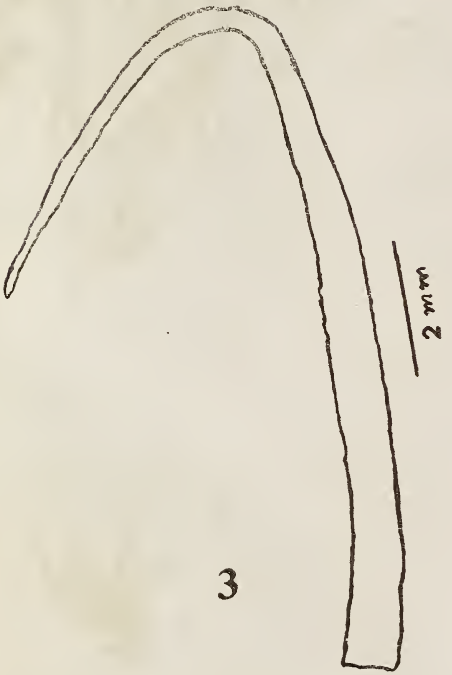

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Fig. 2. Apex of the pinnae showing denticulation.
Fig. 3. Rhizome scale.

Holotypus lectus ad locum Silent Valley, Palghat, Kerala, die 21-4-80 a *Vohra et Ghosh* 56301 et positus in CAL, sub numero collectione.

Isotypi *Vohra et Ghosh* 56301 positi in CAL, et MH.

Pteris silent-valliensis sp. nov.

Rhizome erect, scaly, fronds tufted, dimorphous, simply pinnate, 25-60 cm long, fertile frond larger than sterile one ; stipe purple, base black, triangular, grooved, smooth, glabrous, shining, wiry, much larger than the rachis, usually largest in fertile frond. Stipe of the sterile fronds 12-20 cm long, of fertile frond 15-45 cm long. Lateral pinnae 2-8 opposite pairs, terminal pinnae similar to lateral ones, not decurrent, lower one or two pairs bipartite, Pinnae 10-20 cm long, 5-12 mm broad, glabrous, glossy, green, coriaceous, petiolate, margin of the pinnae entire, apex of the sterile pinnae denticulate ; Rachis naked smooth, greenish, veins once forked, patent, prominent. Sorus continuous along the margin, Indusium membranaceous, spores brown, tetrahedral.

Holotype : way to Kuntipuzha river, Silent Valley, Palghat, Kerala, *Vohra et Ghosh* 56301, 21-4-1980 (CAL).

Isotype : way to Kuntipuzha river, Silent Valley, Palghat, Kerala, *Vohra et Ghosh* 56301 (CAL, MH).

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REFERENCE

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REVIEWS

1. A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN—TOGETHER WITH THOSE OF NEPAL, BHUTAN, BANGLADESH AND SRI LANKA. By SIDNEY DILLON RIPLEY II. 2nd Edition, pp. xxvi+652 (25×17 cm). Bombay, 1982. Bombay Natural History Society Price Rs. 100

In 1961, the distinguished author published the first edition of A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN, at a time when he already had about 35 years of association with the region, and an unrivalled first-hand knowledge of the avifauna of Sri Lanka as well as the north-eastern Himalayas. The first synopsis was undoubtedly a major landmark in advancing knowledge about the sub-continent's bird life, comparable in importance with the publication between the two world wars, of the eight volume FAUNA OF BRITISH INDIA series, authored by Stuart Baker. Perhaps more important it was within the financial reach of a much wider readership and here, briefly the reviewer would like to acknowledge the tremendous personal debt which he derived from this first SYNOPSIS, enabling him after years of frustration to develop a serious interest in the region's bird life.

As stated in the introduction of the 2nd revised SYNOPSIS, the 1961 version formed the basis upon which the ten volume Handbook series (jointly authored by Dr. Sálim Ali and Dr. Dillon Ripley) was published between the years 1969 and 1974. Now, after an interval of over twenty years, there was an obvious need for a revision of the SYNOPSIS especially in view of recent advances in knowledge of less accessible regions, as well as the development of studies in such fields in ethology, ecto-parasites, egg-white protein and genetics, which have thrown new light on phylogenetic relationships. Because of his heavy public responsibilities as Secretary of the famous Smithsonian Institute, not to speak of other multifarious duties as President of the International Council for Bird Preservation and other conservation bodies, the work of revising this 2nd edition appears to have been prolonged over a period of nearly ten years, and indeed it is a wonder that such a painstaking and time consuming task of revision was accomplished at all.

The 2nd edition of the SYNOPSIS attempts to review and bring up to date the latest taxonomic thinking on the avian systematics and the fauna of the region, whilst at the same time highlighting briefly the available information on the status and distribution of each species and sub-species listed. When it is realised that more than 1200 species are covered with a total of 2060 separate sub-species, the complexity and enormous range of such an undertaking can be appreciated. The great strength of this 2nd edition, lies in its coverage of the north-eastern Himalayan region and particularly Sikkim, Bhutan and northern Assam resulting from the author's own personal interest in and many expeditions to these relatively inaccessible regions. Also the comprehensive coverage and new information of the Nicobar and Andaman group of islands (largely as a result of the work done by that doyen of Indian ornithologists, Humayun Abdulali), and also of the avifauna of Nepal, largely as a result of the meticulous recording of the Bob Flemings senior and junior, (see various Fieldiana publication cited in the SYNOPSIS).

If the SYNOPSIS has any weaknesses, these stem from the difficulty of trying to convey meaningful information with the necessity of condensation and simplification, and this particularly with respect to the comments about each sub-species, habitat preferences and distributional status. One could draw the reader's attention to the short descriptive passage on habitat preferences for *Emberiza striolata* (No. 2057 in both editions), whereby a comparison with the 1961 version will show the care and detail which has gone into trying to make the 2nd edition more precise and meaningful. Nevertheless because of the wide range of climatic, edaphic and elevational factors, affecting the environment selected as living space by birds, there is a danger of over-simplification in the categorisation of geographic or forest types used for these descriptions, as well as the distributional information, to the point where the complexity of factors determining a species habitat requirements may be masked. To cite but two examples, the phrase 'resident, subject to vertical movements', fails to convey the great variation in movements which actually occurs in many montane breeding species. For example the more palearctic Sittidae show remarkably little altitudinal movement even in severe winter conditions according to this reviewer's observations in Pakistan, whereas the Certhidae certainly do, yet both families are described in the SYNOPSIS in the same phrase, 'resident, subject to vertical movements'. To take another example describing habitat or breeding range biotope, one could quote the reference to *Myiophonus caeruleus* which the SYNOPSIS describes as 'frequenting rivers and torrents, preferably in heavy forest and not in bare country'. Cliffs and running water this thrush certainly seems to need, but in Baluchistan and to a lesser extent even in Chitral, many breeding pairs can be found in country totally devoid even of stunted bushes.

In the field of taxonomy there will always be a divergence of opinion and controversy, and many specialists will disagree with the treatment given to some of the species in this SYNOPSIS, but all such taxonomic reviews are becoming increasingly indispensable even to the so-called 'field worker', and human understanding often advances more surely where there has been some controversy. Hence this reviewer is confident of the lasting value of this 2nd edition and in the critical comments that follow, it is intended only to convey the stimulus that such a publication is bound to elicit.

With his encyclopaedic knowledge, it might seem invidious to single out any particular sections of the SYNOPSIS for special merit, but it can fairly be stated, that the author is one of the world's leading authorities on the Timaliinae (Babblers, Laughing Thrushes etc.) and the Rallidae and his treatment of these two families/sub-families makes an especially significant contribution. There is quite a major re-arrangement in the sequence of species listed under Rallidae, and this would surely have been more valuable if accompanied by a more adequate explanation of the author's preferences. Every major new review of taxonomic status should aim at trying to reach a consensus and for this reason, a liberal use of footnotes and commentary is not only unavoidable but extremely helpful. Reverting to the Timaliinae, its continued relegation in the SYNOPSIS to sub-family status and more primitive phylogenetic origins than say the Sylvidae seems to ignore recent discussions about the characters of this distinct group (Sibley 1970 : Comparative Study of Egg-white Proteins of Passerine Birds. Bull. Peabody Mus. Nat. Hist. 32) as well as such behaviourists as Simmons (1963. Avicult. Mag.: 69) and such systematists as May and Greenway (1956 : Sequence of Passerine Families : Brevidra. Mus. Comp. Zool. : 58).

The elevation of seven sub-species to full specific rank, in this 2nd edition is of special interest, as indeed are the total of 35 new species added to the 1961 list. Examples of the former, include *Rhyticeros plicatus* the Narcondam Hornbill and *Turdoides rufescens* the Ceylon Rufous Babbler representing regions where the SYNOPSIS has unrivalled coverage. *Sterna saundersii* the Black-shafted Little Tern with which the reviewer is familiar on its breeding territories around Karachi, seems to exhibit less extreme variation in bill and leg colour and wing-tip pattern than many accepted races of the Common Tern *Sterna hirundo* from, for example, the Southeast Pacific region. The Kashmir Red-breasted Flycatcher (*Muscicapa subrubra*), with its markedly different vocalisations and sub-adult male/female plumage patterns when compared with the East European breeding population, would certainly seem to warrant full specific separation.

Considering some of the new species listed, perhaps the most interesting is *Brachypteryx cryptica*, the Enigmatic Shortwing, putting the author alongside that handful of men who have experienced the excitement and renown of discovering new species of birds within the past half century. Four new species are listed for which there are no sight records but which are known to occur in adjacent territories, such as the oceanic Gadfly Petrels, *Bulweria fallax* and *B. bulwerii*, and also the north-eastern Tibetan Black Woodpecker (*Dryocopus martius*) and the Streak-throated Tit Babbler (*Alcippe striaticollis*). The probability of these species being discovered within the territories covered by the SYNOPSIS is certainly high, but their inclusion seems to be quite inconsistent with the basis for inclusion of the rest of the species in the SYNOPSIS, and especially with the deliberate exclusion of *Picus viridis bampurensis*, collected from an area very close to the border of Baluchistan (in Fars Province of Iran). Even if Bampur was wrongly described as falling within Pakistan territory in the 1st edition, the region is ecologically identical to the adjacent Chaghai District of Baluchistan, where *Picus squamatus* has been recorded. It would have been more valuable to know whether Zarudny's identification of *Picus viridis* was supported by specimens.

There are some instances of the continued maintenance of sub-specific status for birds which in a consensus view seem to merit full specific status. Two examples are *Otus scops sunia*, with its exclusively non-palearctic distribution, and stereotyped very distinct breeding season calls, which is generally recognised nowadays, as a separate species, *Otus sunia*, the Eastern Scops Owl (see Gallagher and Woodcock, Birds of Oman, and 'Vocalisations of Indo-Pakistan Scops Owls', Roberts and King in press). The second is *Lanius collurio isabellinus*, admittedly a representative of a taxonomically very difficult group. Several recent authorities have argued the merits for elevation to full specific rank, *viz. L. isabellinus* (see Stresemann, Portenko and Mauersberger, 1971, Vogel 3, Berlin Akad.Verl., and de Voous, Brit. Birds, Vol. 72, No. 12), and because of its remarkably different plumage pattern (especially tail) and breeding distribution at least within Pakistan territory, this distinction seems warranted.

It should be stressed that all such examples are minor questions of personal opinion but their resolution will undoubtedly help every serious field biologist to understand better the ecological requirements or the factors leading to genetic and breeding separation of the different species found in this faunistically rich and diverse region.

In conclusion, the reviewer would like to comment upon one important and perplexing area of information in this revised SYNOPSIS.

This relates to the described status and distribution of species in the north-western part of the sub-continent, where the paucity of recent reliable observers has certainly resulted in too great a reliance upon out-dated distributional information and even in some cases a too uncritical acceptance of earlier records. After thirty-five years residence in this northwestern region the reviewer admits to a heavy bias in such an over view.

To give some examples one may cite some of the records for Baluchistan, based upon C. B. Ticehurst's papers (J.B.N.H.S. Vol. XXXI, 1926 Parts I& II, and Vol. XXXII, 1927 Part III pp. 687-771, pp. 862-881 & pp. 66-97). Though the author admits to very little personal acquaintance with the region and compiles his paper from earlier workers publications as well as unpublished manuscripts and various skin collections, it must be well accepted that he was a meticulous and highly discerning ornithologist, whose opinions would always merit careful consideration. However personal familiarity with the region covering over a score of field trips of which eight or nine were during the spring nesting season, would indicate that the Red-headed Tit *Aegithalos concinnus* certainly does not occur in Ziarat or any high elevation dry *Juniperus* biotope, whilst *Emberiza bruniceps* the Red-headed Bunting only migrates as far south as northern Baluchistan in certain years and there is no evidence of its ever having bred there (despite W. D. Cummings manuscript notes and the nest of this species he purported to have sent to Dr. Ticehurst). Another example is the uncritical acceptance of Colonel Rattrays records for the Murree Hills (Birds Nesting in the Murree Hills and Gallies, J.B.N.H.S., Vol. 16, 1904 & Vol. 16 No. 3, 1905) Colonel Rattray according to his own record relied heavily upon 'native collectors' and none of his skins are preserved in any museum collection though he often averred that 'he shot the female off the nest, to make certain of identification'. Thus, such species as the Drongo Cuckoo (*Surniculus lugubris*), which parasitises exclusively on *Garrulax* species not Dicruridae, whose egg Rattray claimed to have collected, as well as *Ictinaetus malayensis*, *Phylloscopus reguloides*, and *Phylloscopus trochiloides* (see Handbook Volume 9, pp. 167) seem to be listed as occurring in the Murree Hills on the basis of Colonel Rattray's papers. A familiarisation with the breeding songs of all the *Phylloscopi* in Pakistan, and many years of staying in these hills during the spring and summer months indicates to the reviewer that at least during recent decades these particular species have not bred in the Murree Hills, if indeed they even occurred as stragglers. Other puzzling distributional records, worthy of mention, are the inclusion of the Murree Hills for the Rufouschinned Laughing Thrush (*Garrulax rufogularis*) on the basis of Stoliczka's record of Changla Gali, July 1873. No B.N.H.S. or British Museum skins exist west of the Punjab Hill States in India, and because of the profound ecological changes which have occurred due to human population pressure in these Murree Hills, it is about as relevant to cite an 1873 observation, as to quote the sighting in the 1920's of Carolina Parakeets in the Florida Everglades.

Similarly a study of Hugh Whistler's comprehensive manuscript notes, as well as extant skin collections in Bombay and Tring, has failed to clarify why Marshall's Iora (*Aegithina nigrolutea*) is included as occurring in N.W.F.P. and Pakistan Punjab, or why the Allied Grosbeak (*Mycerobus*) *Coccothraustes affinis* in the revised SYNOPSIS is recorded as occurring in the Murree Hills. Indeed the record for the Allied Grosbeak seems to stem from an examination of skins of unknown origin ('The Hills beyond Murree') to quote by Surgeon

General L. C. Stewart in 1886. These two examples are mentioned because they are so much at variance with the present-day known distribution of these two species, both so conspicuous in coloration and loud vocalisations as to be difficult to escape notice.

As our knowledge of the distribution of India's avifauna is increasing with new distributional records coming to notice almost mouth by month, it is clear that no attempt to record the range of species can be final or without shortcomings and a reference to the revised Handbooks citation about the present distribution of the Orange-headed Ground Thrush (*Zoothera citrina*), No. 1733 in the revised SYNOPSIS, together with a recent note recording the occurrence of this species close to Islamabad (see Roberts, J.B.N.H.S., Vol. 78 No. 1, 1981, Misc. notes pp. 73-76) should testify to the fallibility of the reviewer himself in such matters.

To conclude, the revised SYNOPSIS is a worthy successor to the first edition, indispensible to any serious student of Indian ornithology and the oriental zoogeographic region, and this reviewer is grateful for the opportunity which it offers for improving our knowledge and understanding of the region.

T. J. ROBERTS

2. THE PLOVERS, SANDPIPERS, AND SNIPES OF THE WORLD.

By Paul A. Johnsgard. pp. 491 (28 × 21.5 cm) with 60 coloured and 60 monochrome plates and numerous line drawings and distribution maps in the text. Lincoln & London, 1981. University of Nebraska Press. Price $ 45.00.

The Shorebirds or ' Waders ' as a class are very richly represented in the northern hemisphere, the Nearctic and Palearctic Regions possessing by far the largest number of breeding species. They are very poorly represented in the southern hemisphere where the two major subfamilies Calidrinae and Trynginae are totally absent as breeding birds. Plovers, Snipes and Sandpipers are not found on the mainland of Antarctica at all. No worldwide approach to the shorebirds had been attempted since Henry Seebohm's (1888) classical monograph. Their taxonomy remains somewhat unsettled and controversial partly in view of the great diversity in their breeding biology and the crucial importance ethology has acquired in avian taxonomy since Seebohm's day. The breeding biology of shorebirds is enormously variable. There is greater diversity in their mating systems than perhaps in any other Order of birds : there is, among them, Monogamy, Bigamy, Polygamy (both polygyny and polyandry) as well as promiscuity—the last perhaps commoner than hitherto realized. By the special stress it lays on the behaviour patterns of breeding shorebirds the book under review is notable, as it also is for the comprehensive and workmanlike diagnostic keys it provides to Classes, Families, Subfamilies, Tribes and Genera—a feature not available in any other modern work on this universally popular group of birds. Furthermore, the natal plumage pattern of shorebirds is also of great significance in classification ; thus the illustrations of the downy young of as many species as possible make a particularly useful feature.

The main text covers all the shorebirds of the world as named in the title of the book, with general descriptions and identification keys split up into genera, species (and subspecies if any) with their ranges and breeding distributions clearly shown on line maps. Most of the species are beautifully illustrated with line drawings of the complete bird or its head profile, and many also with their diagnostically patterned downy young. In addition to these are 60 beautiful and well chosen colour plates and an equal number of black-and-white ones to round off the general excellence of the publication.

The descriptions of individual species cover information collated from widely scattered sources, but is largely based also on the author's personal observations and on as yet unpublished research. The section on Natural History (which includes habitats and foods, social behaviour, reproductive biology, status and relationships), is the most fascinating and informative for the serious bird watcher as well as the professional biologist.

The appearance of this beautiful and authoritative work on the shorebirds of the world is timely and welcome, not only because nothing so comprehensive was available before but also because it comes from the author of that modern classic, 'Ducks, Geese and Swans of the World'—which sets the zeal of excellence upon it. No good ornithological library can afford to do without this book, and—since shorebirds are among the most fascinating, abundant and easy-to-watch birds anywhere-no serious bird watcher should be without it.

SÀLIM ALI

3. EUPHRATES AND TIGRIS, MESOPOTAMIAN ECOLOGY AND DESTINY. By Julian Rzoska. pp. x + 122 (24.5×16 cm) with 36 text-figures. The Hague—Boston—London, 1980. Dr. W. Junk bv Publishers. Price Dutch Guilders 60.00 ; US $ 31.50.

This small book, comprising Volume 38 of the *Monographiae Biologicae* series, is the third one dealing with rivers, having been preceded by those dealing with the Nile and the Volga.

It is divided into two parts, *viz.* (I) the land and its life, and (II) Mesopotamian waters, regime and hydrobiology. Part I—the smaller of the two (27 pages), has three chapters, dealing with the land, its geology, climate, soils, vegetation (including crops) and archaeology. The author opines that this general setting is necessary so as to give a background against which the second, main, part can be properly assessed.

The second part, with eight chapters, has a more proper bearing on the hydrobiology of the region, comprising present-day Iraq. Even here, the author has thought fit to devote an entire chapter on Near East waters, *viz.* Lake Kinneret (more popularly remembered as the Sea of Galilee), the Dead Sea, and waters of Iran and of the Azraq Oasis.

At last, in Chapter 5, we come to what properly constitutes the studies bearing on the title of the book, covering the origin of these rivers, their length and slopes, hydrology and currents, their use as channels for communication and as life arteries for man. The development of marshes and deltas leading to the Shatt al-Arab through the ages has been vividly described with the help of six maps.

The next chapter, written by J. F. Talling, brings us to the classical aspects of hydrobiology, such as temperature, salinity, turbidity, and chemical composition. Chapter 6A, also by the same person, deals with phytoplankton.

Water vegetation, animal life and benthos are covered in Chapter 7, together with excerpts on malaria and mosquitoes extracted from a book published by the London School of Hygiene and Tropical Medicine in 1950.

The last chapter, written by K. E. Banister, is a fairly detailed account of the fishes of the two rivers.

This book is certainly a new approach to the study of freshwater resources and the author has treated the contained material in a coherent manner. Its scientific terminology and concept seem definitely oriented toward the lay reader, but the format and depth of coverage are probably more suited to a collegiate level.

The book's real failing lies in its brevity. By attempting to condense into a little over a hundred pages what ought to have filled a tome, the author has failed to do justice to its contents. Of course, the magnitude of references is very impressive, and the author, with his interdisciplinary approach, has obviously done a lot of patient researching in libraries.

It may surprise many readers that the Journal of the Bombay Natural History Society was instrumental in publicising the fauna of Iraq with a series of excellent papers between 1920 and 1922, the most oustanding being on (1) butterflies, (2) Hymenoptera, (3) Orthoptera, (4) freshwater Crustacea, (5) Birds and (6) mammals by (1) Peile, (2) Morice, (3) Chopard, Uvarov, (4) Gurney, (5) Ticehurst, Buxton and Cheesman and (6) Cheesman respectively. A note on the Arabian ostrich by S. H. Prater also stands out conspicuously. The author has drawn freely from the 'Handbook of Iraq and the Persian Gulf' issued by Naval Intelligence, Great Britain during 1944—even now a most comprehensive source of information though quite outdated.

Printed on glossy art paper, which does justice to the many photographs therein, the book is well edited. Even then, a few errors have crept in, mainly with place-names. Thus the word 'Sumerian' has been variously misspelt as 'Sumercan' (page 22, line 11) and 'Sumerican' (page 47, line 26), 'Amman' as 'Ammam' (page 35, third paragraph), and 'Mesopotamia' as 'Mesopotania' (map facing page 108). Other minor errors are 'scinks' instead of 'skinks' on page 13 (last paragraph), and '.....erosion products have began....' on line 5 of page 52. The author has used the words 'Persian' and 'Arabian' Gulf interchangeably at several places, possibly to avoid offending political diehards.

If the reader finds the book too superficial, its real failing lies not with the author, but with users who do not heed his admission, in his Introduction to the book, that the book offers only a 'birds eye view'. Priced at a hefty US $ 31.50, it is an excellent source-book of references for the Iraqophile, but definitely not for the common Indian or ecologist.

B. F. CHHAPGAR

4. MATERIAL FOR A FLORA OF THE TAMILNADU CARNATIC.

Volume I—Documentation Volume. By K. M. Matthew. pp. x + 469 (25 × 17 cm) with 20 plates and 2 maps. Tiruchirapalli, 1981. Published by Rapinat Herbarium, St. Joseph's College, Price Rs. 100, £ 15.00, $ 40.00

This is the first—Documentary Volume—of the proposed three-volume flora of a part of the Tamilnadu State, which covers almost 25% of the total area of the state. This volume consists of three parts. The first part deals with the reasons for selecting this particular area, topography of the region and various traditional methods used in this investigation. The second part consists of the actual documentation or the check-list of citations of 32,000 specimens belonging to 2376 species of vascular plants available for study in the five main South Indian herbaria. The third part is devoted to the Rapinat Herbarium and the Anglande Institute of Natural History, Palni Hills.

The author, Dr. K. M. Matthew, is an acknowledged Systematic Botanist and his works, 'The Exotic Flora of Kodaikanal', 'The Flowering Plants of Kurseong' and his monograph on 'Genus Mastixia' are well known. In introduction to this volume he has proposed that there should be some selective centres of collaboration between the Botanical Survey of India and The Universities and reports of such joint schemes should be published in the appendix to the Bulletin of Botanical Survey of India. This is a very welcome suggestion But his claim that, 'The days of general plant collecting are over and the future of Systematic Botany in India lies in monography', does not sound appealing. Hooker's Flora of British India is outdated with respect to nomenclature and number of new additions to the flora subsequently and the monographic revisions of various families are necessary, the task in which Botanical Survey of India is already engaged. However the pace of the work is rather very slow. But the general collections in regions unexplored is also important.

The presentation of the volume, in general is good and certainly will be of good help to the research students of Systematic Botany, but it is felt that the documentation of specimens would have been better placed in the text, following the Taxonomic Treatment of each species.

Due to Government subsidy, the volume is considerably underpriced and should be accessible to all pockets.

M. R. ALMEIDA

5. **THONNER'S ANALYTICAL KEY TO THE FAMILIES OF FLOWERING PLANTS.** By R. Geesink, A. J. M. Leeuwenberg, C. E. Ridsdale & J.F. Veldkamp. pp. xxvi + 231 (22.5 × 15 cm). The Hague/Boston/London, 1981. PUDOC, Centre for Agricultural Publishing and Documentation, Wageningen ; Leiden University Press. Price Dfl. 38.50/US $ 21.00 (Paper back).

The book is based on the comprehensive analytical key for the Flowering Plants by the Austrian Franz Thonner (pp. xii-xxi) in German, whose final (1917) edition was reached after 30 years of original work. Unfortunately the language being German and the author being a private botanist largely led to overlooking this important work. The present authors are a team of young botanists of the Rijksherbarium, Leiden, Netherlands, well equipped with adequate knowledge of the tropical plants through their work for the *Flora Malesiana.*

The work is no mere translation (even the number of couplets has gone up from 812 of Thonner to 2117 in the present book) ; it gives an adequate contemporary coverage of Flowering Plants within Thonner's framework. A concise introduction (pp. viii-ix) justifies the enterprise referring to existing works. The authors make no exaggerated claim but insist that this is a book in the making (which is not ?), and should be improved by international collaboration (after all, any future work of this kind should be team work). Deletion of lead 225 reminds one that the book is in the making. The authors explicitly invite criticisms, suggestions and improvements. An imposing list of competent workers who have already been consulted (pp. x-xi) indicates the considerable amount of improvement already achieved.

Pages xxii-xxv give instructions on how to use the key (this is no ' without tears ' series !), which incidentally explain how to prepare parts of herbarium materials for analysis and study. Certain leads separated by a dash (—) the first part strictly contradicting the corresponding lead of the couplet, the second part giving additional information is a wise device of adhering to the exigencies of the dichotomous key without sacrificing vital information that cannot always be contradicted by the corresponding lead of the couplet. Cross references to widely separated leads are helpful. Multiple entries are, of course, unavoidable, but can be easily managed from the detailed index (pp. 214-231). A comprehensive Glossary (pp. 198-213) explains all the technical terms used.

The modesty of the authors is denied by the amount of information and expertise the book contains. Firsthand knowledge is written across the text. It is a massive and painstaking effort, a labour of love where the margin between work and pleasure is blurred ! One of the authors orally claimed 90% efficiency for this key as against 65% for Hutchinson.

This book can be particularly useful in India as a paçe-setter if systematic botanists turn to the long-overdue monography which is the core of systematic botany rather than the niceties of ' nomenclature ' or the publishing of ' new ' species or even records. *An immediate task for the next mere five years could be the writing of a similar key for the national and the provincial floras by the available workers in the field.* In such a context, the present work (despite its Engler and Prantl sequence, not well known in India) cannot only be useful but stimulating; else the danger is that this also will adorn library shelves as many imported and expensive tomes do now.

This rigorously worked, neatly printed, excellently produced and moderately priced book is warmly recommended for creative workers in systematic botany. An Indian reprint may be possible if the demand is adequate.

K. M. MATTHEW

6. A REVISED HANDBOOK TO THE FLORA OF CEYLON. Edited by M. D. Dassanayake & F. R. Forsberg, Vol. I, pp. vii + 508 (24 × 15 cm). Vol. II, pp. vii + 512 (24 × 15 cm) with many illustrations. New Delhi, 1980 & 1981. Published for the Smithsonian Institution and The National Science Foundation, Washington, D.C., by Amendri Publishing Co. Pvt. Ltd. Price Rs. 125 per volume.

This series of the revised handbook is intended to revise the handbook to the flora of Ceylon, by Henry Trimen, published in five volumes between 1893 and 1900, and an additional volume added by A. H. G. Alston, in 1931.

According to the information available from the publishers, the proposed plan is to publish entire revised work in seven volumes, out of which three are already out of press.

According to the two volumes at hand for the review of this work, it appears that each volume will contain 10 families, at random, as and when the revision is complete and manuscripts are placed in the hands of the editors.

Some of the families are revised by their respective world authorities, but although the editors claim to have suggested one, there is no definite format and different authors have followed their own style. Application of the International Botanical Nomenclature is left in the final authority of the authors and this has resulted in acceptance of many outdated names in the case of at least one family (Family-Orchidaceae) which is otherwise a well presented account.

There is no index given at the end of each volume. The editors have promised to give a comprehensive index to these volumes, in a separate volume, but until the series is complete the reader has to locate the published families on their own.

The general quality of the work is quite good and financial help from Smithsonian and National Foundation has made the price suitable to all pockets.

The two volumes available for review contain following families :

Vol. I :

1. Amaranthaceae	by C. C. Townsend
2. Bombacaceae	by Andre G. Robyns
3. Clusiaceae	by A. J.G. Kostermans
4. Mimosaceae	by A. J.G. Kostermans
5. Compositae	by A. J. C. Grierson
6. Connaraceae	By Deva Duttun Tirvengadum
7. Convolvulaceae	by Daniel F. Austin
8. Dipterocarpaceae	by P. S. Ashton
9. Elatinaceae	by S. H. Sohmer
10. Fabaceae	by Velva E. Rudd.

Vol. II :

1. Apostasiaceae	by D. M. A. Jayaweera
2. Orchidaceae	by D. M. A. Jayaweera
3. Bignoniaceae	by William L. Theobald
4. Lemnaceae	by F. N. Hepper
5. Myrtaceae	by P. S. Ashton
6. Pittosporaceae	by Deva Duttun Tirvengadum
7. Primulaceae	by S. H. Sohmer
8. Proteaceae	by C. Townsend
9. Rhizophoraceae	by W. Macnae & F. R. Fosberg
10. Thymelaeaceae	by C. Townsend.

M. R. ALMEIDA

7. AN INTRODUCTION TO PLANT NOMENCLATURE. By S.S.R. Bennet.

pp. ix+77 (18.5×13 cm) Dehra Dun, 1979. International Book Distributors.
Price Rs. 12.

This booklet is prepared by the author to explain the special features of International Code of Botanical Nomenclature to the students of Botany especially to those who are required to study the various aspects of naming of plants. The booklet explains in the first chapter the ranks of various groups of plants (Taxa), the forms of scientific names, citation of authors and literature, abbreviations and six principles of the Code. In the next chapter the nomenclatural terminology is explained, and dates of publications (effective and valid) are discussed. The last chapter gives several interesting exercises in nomenclature of Indian plants which are discussed.

The booklet ; as stated by Prof. M. B. Raizada, a doyen of Indian plant taxonomy, will indeed be welcome for the student and layman to understand the principles of plant nomenclature and will dispel the misunderstanding in the mind of those who consider the name changes as meaningless exercise.

P. V. BOLE

8. APPLIED BOTANY ABSTRACTS. Vol. 1, Nos. 1 & 2. Editor B. R. Juneja.

pp. 1-112 & 113-244 (24.50×18.50 cm), Lucknow, 1981. Economic Botany Information Service, National Botanical Research Institute (NBRI). Annual Subscription Rs. 50 ; £ 10 ; $ 20.

This new Quarterly containing abstracts on Applied Botany is a Quarterly abstracting periodical brought out by NBRI, Lucknow. It covers world literature on Research and development work, aiming at utilisation of the wild and non-agricultural/non-traditional/underutilized economic plants and plant products and development of production technologies for new plant sources of useful products. The first two issues cover 530 entries under 8 sections besides book and periodical reviews. Each issue contains Key word Index and authors' index with an appendix listing journals consulted.

The sections under which the entries are tabulated are (1) non-agricultural/non-traditional/under-utilized plants for—(*a*) non-edible oils and waxes (*b*) proteins and amino-acids (*c*) starches and sugars (*d*) gums, mucilages and resins (*e*) fibres and other cellulose products ; (2) Biomass/energy plants for—(*a*) fuel crops, petro-alcohol—crops (*c*) latex lubricant crops ; (3) Ornamental plants ; (4) Plants and environmental pollution ; (5) Traditional herbal drugs—(*a*) Pharmacognosy (*b*) botanical standardisation ; (6) Ethnobotany ; (7) Endangered/Threatened plants ; (8) Other economic plants.

The National Botanical Research Institute deserves compliments for rendering this very valuable service to the cause of research and development of application of botanical sciences to the utilisation of plant resources in India and elsewhere.

P. V. BOLE

MISCELLANEOUS NOTES

1. THE WESTERN LIMIT OF PIGTAIL MACAQUE DISTRIBUTION IN ASSAM

The pigtail macaque, *Macaca nemestrina*, is found in continental Asia from Assam through southern Burma and western Thailand to the Malay Peninsula, extending to Sumatra, Borneo and the Mentawai Islands (Medway 1970). In Assam it apparently is confined to the Naga Hills (four specimens collected by McCann, 1933), but to what extent does it occur there and elsewhere in Assam is unknown (Prater 1971). Because pigtail macaques are hunted for food throughout most of their range, they are wary and adept at evasion (Bernstein 1967). This predation pressure may partially account for the paucity of observations on wild populations. Their present status in Assam is evaluated here.

In July-August 1971 and December-February 1972-73, I spent 62 days censusing hill forests bordering the Brahmaputra Valley of Assam. Hill tracts of the Garo, United Khasi-Jaintia, Mikir and North Cachar Hills lying south of the Brahmaputra River and the Dafla Hills north of the river were the principal areas visited. Rhesus macaques, *Macaca mulatta*, are common in all of these hill tracts. Their range of habitat varied from the fringes of tropical evergreen and mixed deciduous forest to cultivated tea gardens and temple areas. The pigtail macaque, however, does not occur north of the Brahmaputra and is rare or absent in the south. None were found in the Garo and United Khasi-Jaintia Hills, and interviews with local forest officers concurred. These results also apply to the Mikir Hills in Nowgong District. The North Cachar Hills in the Barak Plains and the Naga and Patkai Hills in upper Assam, which border Burma, are restricted areas and were not surveyed. Forest officers I interviewed from North Cachar were unsure if pigtail macaques were in their areas, but they apparently do occur in the northern districts of Sibsagar, Lakimpur and Tirap (P. Baruah, personal communication).

I observed one troop of 26 pigtail macaques in Hollongapar, an 1800 ha evergreen Forest Reserve 12 km south of Jorhat, Sibsagar District (26°70′N, 94°30′E) in upper Assam. These macaques, encountered on nine different days, were easy to observe and exhibited no signs of flight upon my approach. No solitary individuals or smaller groups were observed. The troop kept mainly to the lower canopy (5-10 m high), but some individuals occasionally travelled and fed on the forest floor. Feeding was concentrated on fruits and leaves. Pigtail macaques apparently have extensive home ranges, and whether they are confined entirely to Hollongapar Forest Reserve is unknown. Hollongapar is one of the few stands of evergreen forest outside of the extensive tracts found in the hilly northeast. Thus, this forest, which is about 80 km west of the Naga Hill forests, probably is the western edge of extant pigtail macaque distribution in Assam.

RONALD L. TILSON

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2101 NE 50TH,
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U.S.A.,
February 16, 1982.

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Medway, L. (1970): The monkeys of Sundaland. *In* Old World Monkeys Evolution, Systematics and Behaviour. J. Napier and P. Napier, eds., New York: Academic Press.

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2. DOMINANT BEHAVIOUR OF A SUB-ADULT MALE LION-TAILED MACAQUE IN SEMI-NATURAL CONDITIONS

In Mundanthurai Sanctuary (8°33′N, 77°27′33″E ; 214M) near the Forest Rest House an orphanage for young wild animals, found abandoned in the forests is maintained. The Rest House is situated at the confluence of two perennial rivers Servalar and Thambaraparani and enjoys a cool microclimate. Two juvenile a ♀ (Rani) and a ♂ (Raja) Lion-tailed Macaques and an infant Bonnet Macaque (Raufali) brought by Rauf Ali were kept in a cage during night, but were permitted to move freely during day. They were fed with milk, eggs, cooked rice, peanuts, plantains and other fruits as prescribed by the Forest Veterinary Officer. Raja and Rani extended affection and exhibited protective behaviour toward Raufali, the Bonnet infant. Without having any familiar relationship of their own they formed a well knit troop, were attached to each other and were tolerant of others ; when visitors touched or gathered Raufali, Raja and Rani objected or resisted. They slept huddled together, Raja and Rani held close the Bonnet infant against their abdomen and breast as mothers would care. Raja carried along Raufali in ventro-ventral position for short distances. Raja was the natural leader and would lead them out of the cage on to the surrounding trees (Tamarind, Neem, *Eugenia Hopea*, Teak, *Albizzia*, *Delonix*) to the roof tops and into the kitchen, Rest house, office room and residential quarters.

During feeding time, morning, noon and evening two Bonnet Macaque troops visited areas around the cage in search of left overs. One was Periappa's troop named after the dominant male Periappa, the other was Rauf Ali's study group. The visiting bonnet macaques often pestered by stealing food given to the Lion-tailed Macaque. An all male Nilgiri Langur troop also visited the Rest House area, though not specifically the cage area. Social interactions between the Lion-tailed Macaque and visiting Bonnet Macaques that occurred in the semi-natural conditions were observed during the period between August 1978 and May 1979 and recorded, whenever observed.

Allogrooming :

Allogrooming between Lion-tailed Macaque and Bonnet Macaques were observed on 54 occasions. This inter-specific allogrooming was noticed between Rani and or Raja *Macaca silenus* with or without Raufali and with visiting *Macaca radiata* troop of which only on 4 occasions Rani was involved. In all the four occasions, Raja also was around. The grooming bouts were of short duration upto 9″-3′3″ and within a radius of 50 metres of the cage though Raja and Rani roam about intra-specific grooming is a common interaction within troop among *Macaca radiata*, which showed the greatest degree of contact behaviour. The primary recipient of the grooming activity here was Raja. On several occasions Raja solicited grooming by lying on its side directly before sitting or slowly moving Bonnet Macaque A♀ and SA♀ which readily responded by grooming. Raja also reciprocated by grooming, holding, hug-holding and hurdling. The grooming participants at one time were never more than three in number. The Bonnet Macaque SA♀ often wrestled rolled over one another before and after grooming. The consistency with which grooming was directed towards Raja, probably indicates Raja was dominant.

Raja mounted A♀, SA♀, and SA♂ ; it could not be known whether the ♀S were in oestrus, the mounting did not last for more 4-9 seconds. The mounting appeared casual, imprecise and without direction.

Pouch examination :

Raja examined on 18 occasions the pouch contents of Bonnet Macaque (7A♀, 2SA♀, 9SA♂) on 3 occasions it removed the contents and put into its own mouth. (Contents could not be identified.) On all other occasions Raja threw away at least what all he had removed from the pouch. On all occasions the Bonnet Macaques were passive and did not protest. On one occasion the Bonnet collected what was thrown away by Raja and put it back in its mouth. The 'pouch examination' was not performed during feeding hours. I have not noticed Raja 'pouch examining' either Rani or Raufali.

When a Nilgiri Langur *Presbytis johnii* all male troop of 4-7 members approached the Rest house, Raja ran towards them and chased them. When it ran towards a Nilgiri Langur, the Nilgiri Langur generally moved away. Nilgiri Langur and Bonnet Macaque avoided Lion-tailed Macaque in Forests and disappear when latter is in the vicinity. When dogs came near the Rest house, Rani and Raufali climbed the nearest tree while Raja stood or chased (2 observations).

The behaviour of Raja can be considered in the light of the following factors :

1. The formative age of Raja and its companions Rani and Raufali and lack of troop tutelage.
2. Assured food supply at the orphanage.
3. Play and/or curiosity (characteristic of its age) motivation.
4. Being an orphan, a craving for social contact. But the generally domineering behaviour of Raja is interesting though intriguing and difficult to explain.

WILDLIFE WARDEN,
OFFICE OF THE MUDUMALAI WILDLIFE SANCTUARY,
UDHAGAMANDALAM-643 001, TAMIL NADU,
September 8, 1981.

J. MANGALRAJ JOHNSON

3. ANDERSEN'S RUFOUS HORSESHOE BAT, *RHINOLOPHUS ROUXI SINICUS* ANDERSEN (CHIROPTERA : RHINOLOPHIDAE) FROM ARUNACHAL PRADESH, INDIA

A specimen of bat collected by the Zoological Survey of India during an expedition to Subansiri District, Arunachal Pradesh in 1974 was identified as Andersen's Rufous Horseshoe Bat, *Rhinolophus rouxi sinicus* Andersen, which has not been recorded from this area.

Rhinolophus rouxi sinicus Andersen, 1905 *Proc. zool. Soc. Lond.* 2 : 98 Chinteh, Anhwei, Southern China.

MATERIAL : 1♂ (ZSI Reg. No. 19780) : Siki, *c* 15 km from Taliha (*c* 500 m alt.), Subansiri District, Arunachal Pradesh ; 24 Nov. 1974 ; J. M. Julka Coll.

Measurements : (Taken from alcohol preserved specimen). All measurements are in millimetre.

External : Length of ear 15.5 ; Length of noseleaf 10.0 ; Width of horseshoe 7.4 ; Length of forearm 46 ; Length of 3rd metacarpal 34.2 ; Length of 4th metacarpal 35.0 ; Length of 5th metacarpal 36.0 ; Length of tail 22.2 ; Length of tibia 20.0 ; Length of foot and claw 8.9.

Cranial : Total length 19.4 ; Palatal Length 5.9 ; cranial width 8.7 ; inter orbital width 3.0 ; Length of upper tooth-row 7.6 ; Length of Lower tooth-row 8 ; width across molars 7.6 ; mandibular length 13.2.

Distribution : According to Ellerman and Morrison-Scott (1951), the distribution of this bat is Szechuan, Yunnan, Fukien and Chekiang in China. The present material, therefore, constitutes the first authentic record of the species from India in Arunachal Pradesh, extending its range further westward to within Indian limits.

ZOOLOGICAL SURVEY OF INDIA,
8, LINDSAY STREET,
CALCUTTA 700 087.
February 8, 1982.

J. P. LAL

REFERENCE

ELLERMAN, J. R. & MORRISON-SCOTT, T. C. S. (1951) : Checklist of palaearctic and Indian Mammals 1758-1946. *British Museum* (*Nat. Hist.*) London.

4. STOMACH CONTENTS OF A COMMON PALM CIVET, *PARADOXURUS HERMAPHRODITUS* (PALLAS)

The following account retrieved from my diary, on 31st March 1979, when I was residing at Tikerpada beside the River Mahanadi, within the Satkoshia Gorge Sanctuary, Orissa provides first hand information on the feeding habit of the common palm civet, *Paradoxurus hermaphroditus* in the wild.

At 6.00 in the morning two civets, thought to be a courting pair, were noticed near our Gharial Yearling enclosure. Dwitikrishna, Iswara and Ajai (staff of the project) were able to corner one of these and catch it with a towel. When I was called to see the catch, it was struggling hard to escape from captivity in a cage (40×40×40 cm over a stand of 30 cm high). I decided to offer it an escape, if it could manage from the partially open-roofed enclosure of the muggers (*Crocodylus palustris*), or serve as food to them as they have been forced to be predominantly fish-eaters.

In the afternoon when I saw M1 (the large male mugger) was still unsuccessfully trying to open the civet and eat it, I decided to skin his kill and offer him the meat. Although the civet was dead because of me, I do not regret since it provided good information to guide in the future.

The civet was a male with a total body length 120 cm (snout-vent length 74 cm, tail 46 cm), maximum girth 20 cm and weight (after five hours of kill but without visible sign of decomposition) 2.950 kg, producing meat and bone of 2.150 kg.

The stomach contained the following : (1) Seeds of 'Kendu' fruits (*Diospyros melanoxylon*) : 7 nos. (from at least two fruits) ; (2) some fleshy white root : 3 pieces, each app. 1 cm cube ; (3) *Eublepharis hardwickii* (gecko) : 1 no., 5 cm long ; (4) portions of 2 scorpions, 15 cm and 8 cm long ; (5) centipedes: 2 nos. (portions of a small and a large specimen) ; (6) Viper snake : 1 no., 40 cm TBL, 36 cm SV ; (7) *Typhlops* : 3 nos., 14.5, 7.5 and 7.0 cm length ; and (8) cockroach : 1 no., complete wings and only portions of abdomen exoskeleton found.

The intestine was without digested food. In the distal parts it was partially filled with excreta with portions of a tape worm. The pancreas indicated some nematode infection.

Discussion : Civet attacks on domestic hens are commonly reported in villages and city suburbs. Their liking for palm toddy, is reflected in the common name 'Toddy cat'.

Food offered to civets in zoos constitute a mixed vegetarian and non-vegetarian diet. Dobroruka (1978) states that one cub in Dvur Kralove Zoo refused meat upto 2 months, and oranges were usually refused while preferred food were bananas, and tomatoes.

If, as it is presumed, the male was courting the female before capture, the season closely corresponds to that reported for captive specimens at Dvur Kralove Zoo by Dobroruka (1978) (mid-February) and at Nandankanan Biological Park, Orissa by Acharjyo and Mishra (1980) (late February). However commencement of the breeding season for a species in captivity may be earlier than in the wild.

The flesh of the civet is used in indigenous medicine. 'Netra (a Munda tribal-head working under the project) told me that small pieces of the meat are kept in linseed oil in a closed earthen pot and regularly sunned to finally extract an oil which is used as a cure for scabies. 'A dried piece of the testis heated with ghee from cow's milk, when cooled can be used as a medicine for a type of lips and tongue disease (in Orissa called: Áliti ghá) seen in children less than a year old. The same product also cures skin sores due to contact with the poisonous urine (?) of spiders'.

The Common Indian Palm Civet is called 'Sáliá Patani.' in Oriya language

I wish to thank the Orissa Forest Department and the staff of the Gharial Research and Conservation Unit, Tikerpada for assistance.

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5. BIRTH OF WHITE TIGER (*PANTHERA TIGRIS*) CUBS TO NORMAL COLOURED TIGERS IN CAPTIVITY

(*With a text-figure*)

The White Tiger (*Panthera tigris*) is a magnificent snow white animal with ash or light black stripes, pink paw pads and ice-blue eyes. All the white tigers so far available in captivity had their origin from a male White Tiger named 'Mohan' captured from the forests of Rewa (Madhya Pradesh) in May, 1951 at an estimated age of about nine months. The present communication deals with the birth of three White Tiger cubs in one litter at the Nandankanan Biological Park, Orissa to a pair of normal coloured tigers with apparently no known history of having any relation with the White Tiger 'Mohan'.

A normal coloured tigress 'Ganga' whose mating with a normal coloured tiger 'Deepak' was observed from 24-9-79 to 3-10-79 in the Park, gave birth to three White Tiger Cubs (two females and one male) on 8-1-1980. This is the result of a father-daughter mating.

The body colour of the cubs were snow white with light black stripes, pink paw pads and ice-blue eyes. The eyes of the cubs opened on 12th day (one male and one female cubs) and on 11th day (right eye) and 12th day (left eye) in case of the other female cub.

The weight and size of these cubs recorded after about 48 hours on 10-1-1980 were as follows: weight—1.210 Kg (female), 1.240 Kg (female) and 1.385 Kg (male) and measured 50 cm tip to tip including 15 cm long tail

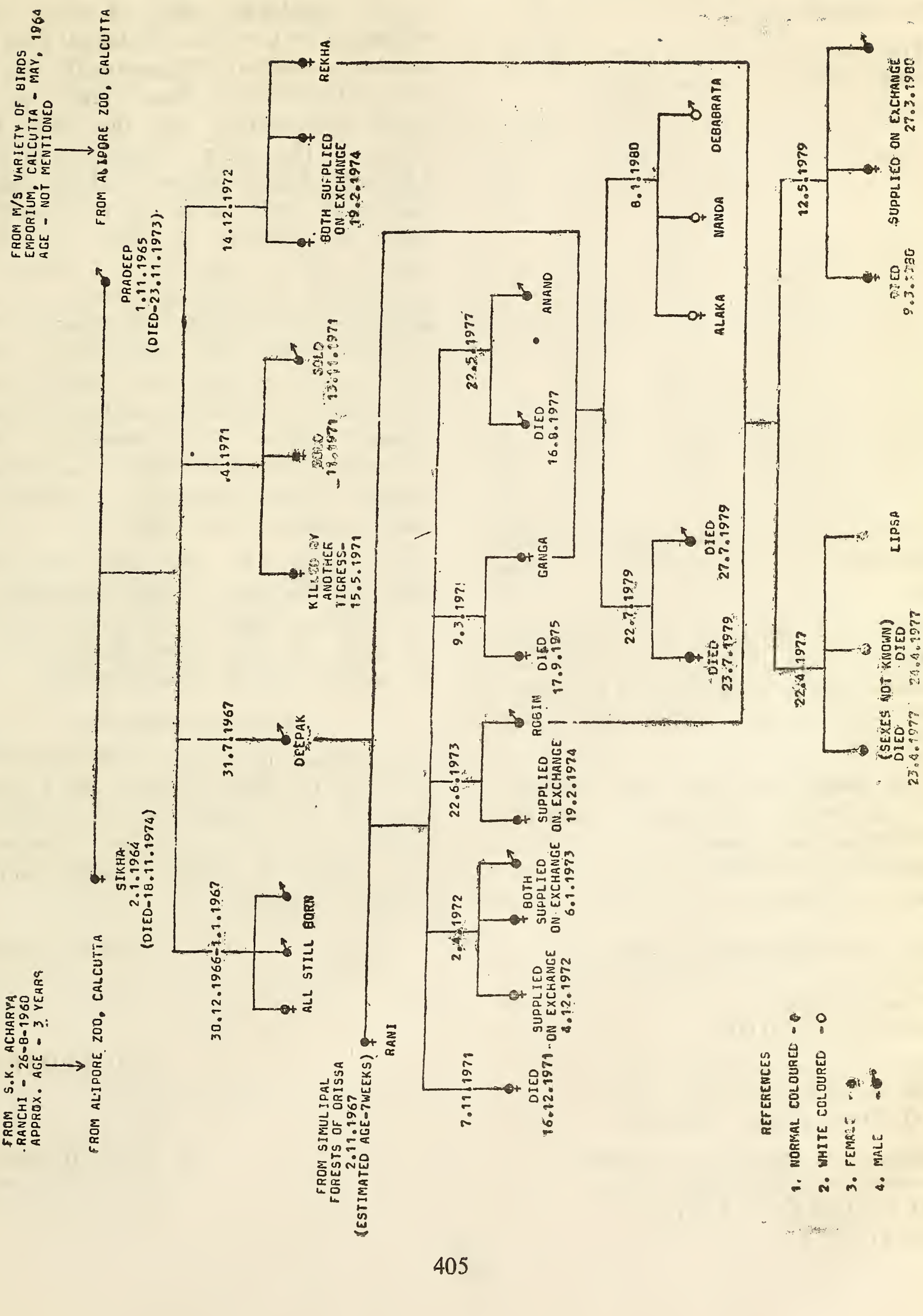
FROM S.K. ACHARYA
RANCHI - 26-8-1960
APPROX. AGE - 3 YEARS
FROM ALIPORE ZOO, CALCUTTA
SIKHA
2.1.1964
(DIED-18.11.1974)
FROM M/S VARIETY OF BIRDS
EMPORIUM, CALCUTTA - MAY, 1964
AGE - NOT MENTIONED
FROM ALIPORE ZOO, CALCUTTA
PRADEEP
1.11.1965
(DIED-23.11.1973)
30.12.1966-1.1.1967
ALL STILL BORN
31.7.1967
DEEPAK
4.1971
KILLED BY ANOTHER TIGRESS-
15.5.1971
SOLD
13.11.1971
SOLD
13.11.1971
14.12.1972
BOTH SUPPLIED
ON EXCHANGE
19.2.1974
REKHA
FROM SIMULIPAL
FORESTS OF ORISSA
2.11.1967
(ESTIMATED AGE-7WEEKS)
RANI
7.11.1971
DIED
16.12.1971
2.4.1972
SUPPLIED
ON EXCHANGE
4.12.1972
BOTH
SUPPLIED
ON EXCHANGE
6.1.1973
22.6.1973
SUPPLIED
ON EXCHANGE
19.2.1974
ROBIN
9.3.1975
DIED
17.9.1975
GANGA
22.5.1977
DIED
16.8.1977
ANAND
22.7.1979
DIED
23.7.1979
DIED
27.7.1979
8.1.1980
ALAKA
NANDA
DEBABRATA
22.4.1977
(SEXES NOT KNOWN)
DIED
23.4.1977
DIED
23.4.1977
LIPSA
12.5.1979
DIED
9.3.1980
SUPPLIED ON EXCHANGE
27.3.1980
REFERENCES
1. NORMAL COLOURED - ●
2. WHITE COLOURED - O
3. FEMALE - ♀
4. MALE - ♂

Fig. 1. Chart showing the genealogy of white tiger cubs born at the Nandankanan Biological Park, Orissa.

(females) and 52 cm tip to tip including 16 cm long tail (male).

The growth rate of these cubs to the age of 3 months were recorded as follows :—

Date	Age	Cub No. I (female)	Cub No. II (female)	Cub No. III (male)
		Kgs.	Kgs.	Kgs.
10.1.1980	48 hours	1.210	1.240	1.380
5.2.1980	4 weeks	3.400	3.800	3.705
12.2.1980	5 weeks	3 800	4.200	4.000
19.2.1980	6 weeks	4.200	4.800	4.200
26.2.1980	7 weeks	4.800	5.200	4.800
4.3.1980	8 weeks	5.200	5.600	5.400
11.3.1980	9 weeks	6.000	6.400	5.800
18.3.1980	10 weeks	6.800	7.200	6.400
25.3.1980	11 weeks	7.600	8.200	7.200
1.4.1980	12 weeks	8.800	9.200	8.200
8.4.1980	13 weeks	9.500	10.400	9.400

The incisors of the cubs appeared in the fifth week and the canines appeared in the seventh week.

Earlier the female of this pair of normal coloured tigers gave birth to two normal coloured tiger cubs on 22-7-1979 but both cubs died within six days as the mother failed to nurse them.

The genealogy of these white tiger cubs is given in the chart (Fig. 1). A study of the genealogical chart reveals that 31 tiger cubs were born in 13 litters out of which only one litter was of white colour, i.e. 7.69% of the litters and 9.67% of the cubs were white. The study of this genealogical chart of white tigers maintained by the Delhi Zoological Park and reported by Saharia (1979) apparently does not give an indication of these white tiger cubs having any relation with the white tiger 'Mohan'. The origin of tigers received from Alipore Zoological Gardens, Calcutta beyond the Animal Dealers could not be ascertained. There were reports of white tigers being shot in Orissa (Gee 1964 a). Perusal of the available literature (Gee 1964, a and b, Sankhala 1969, Oswald 1960, Saharia 1979, Robinson 1928, Pant and Dhariyal 1979) did not reveal any information about the birth of all white coloured cubs in one litter to normal coloured parents. The genealogical chart further suggests that the tigers 'Deepak' and 'Ganga' were heterozygous having the recessive gene for white colour.

The pairing of the white tigers born in the Park with the white coloured descendants of the white tiger 'Mohan' can prevent inbreeding and thus may give better chances for the breeding and survival of the white tigers.

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6. AN INSTANCE OF FOSTERING IN CAPTIVITY IN THE WESTERN GHATS SQUIRREL, *FUNAMBULUS TRISTRIATUS* WATERHOUSE

The behaviour of fostering was already observed and studied in several rodents (Denenberg *et al.* 1963, Muul 1970, Grota 1973, Ajayi 1975). In all these studies the mother was not exposed simultaneously to her own litter and that of others. In this short communication an instance where a mother Western Ghats Squirrel (*Funambulus tristriatus* Waterhouse) suckled and reared the young ones of another squirrel along with her own is reported.

On 6 April 1978 I collected two young *F. tristriatus* weighing 14.25 g (♂) and 17.5 g (♀) from a nest. Their eyes were yet to be opened. The female had developed only the lower, while the male had both upper and lower incisors. Pelage development was incomplete. From these characters the age of this litter was assessed as approximately 20 days. These young ones were placed in the cage (75 × 30 × 30 cm) of a female *F. tristriatus* which was rearing her own 40-day-old litter. At first the mother squirrel was little ' aggressive ' towards the new comers, but later on she suckled and reared them along with her own litter. Within a week the fostered young ones opened their eyes and increased in body weight to 18.50 and 21.50 g respectively. They were raised by the foster mother until weaning.

Denenberg *et al.* (1963) opined that the longer the mothers had been lactating before being given foster young, the higher was the mortality percentage. In abino rats Denenberg *et al.* (op. cit.) observed that fostering to 5 or 10 day lactating mothers resulted in significant increase in the rate of mortality. In the present study the Western Ghats Squirrel adopted the litter of another female even at 40 days post partum. This phenomenon could be taken advantage of in rearing squirrels in captivity.

The financial assistance received from the CSIR, New Delhi for the conduct of the studies on squirrels is gratefully acknowledged.

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7. ON THE OCCURRENCE OF *VANDELEURIA OLERACEA* IN A RURAL RESIDENTIAL HABITAT IN THE DESERT BIOME OF RAJASTHAN

During pest control estimation of rodent population in a village complex near Jodhpur (26°18′N — 73°01′E; mean annual rainfall 366.0 mm), a living specimen of the long-tailed tree mouse, *Vandeleuria oleracea* was captured inside a *Kuchha* hut, feeding upon jaggery in a container in the kitchen. The hut was located in a 3 hectare agricultural land and was surrounded by plantations of Neem, *Azadirachta indica*, Ber, *Zizyphus mauritiana and* citrus. Hitherto, this species has been recorded from several localities in Gujarat (Ellerman 1961) and Bisalpur (25°7′N, 73°10′E; mean annual rainfall 499.7 mm.) in South-western Rajasthan (Rana 1980).

The present report extends the range of *V. oleracea* further north in the desert biome of Rajasthan, and from a residential/premise which has not been hitherto reported.

We are grateful to Dr. H. S. Mann, Director, CAZRI, Jodhpur and Dr. Ishwar Prakash, Professor of Eminence for providing necessary facilities and encouragement.

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8. ON FACTORS GOVERNING THE DISTRIBUTION OF WILD MAMMALS IN KARNATAKA—A COMMENTS

S. Narendra Prasad *et al.* (*JBNHS* 75, No. 3) have made a commendable effort in their paper to present a consolidated picture of distribution of wild mammals in Karnataka. I am sure, this paper, though admittedly based on subjective methodology, will be quite useful for those interested in scientific wild life management in Karnataka. As an amateur naturalist who has investigated the status of wild life in some of these forests in the past fifteen years, I have some comments on this pioneering effort.

1. As pointed out by the authors food availability is perhaps the main reason for the comparatively higher abundance of larger mammals in dry/moist deciduous forests as against evergreen western ghat forests in Karnataka. However, another important factor is that historically the region with evergreen forests has had a greater abundance of fire-arms and tradition of hunting when compared to the deciduous forest regions. This also has, in my opinion, decisively affected the current population status of larger wild mammals.

2. Though the paper covers 86 forest ranges, some other forest ranges/areas which do harbour wild mammals have been omitted for some reason. Some of these are: Bhadravathi, Tarikere and Channagiri (all in Malnad region). Hunsur, and Periyapatna (Mysore plateau region). Arasikere, Melkote, Chitradurga, Chittapur, Chincholi, and Sandur (all in Maidaan region).

3. The various maps and tables giving the occurrence ratings and frequency are based on Table 7, which forms the foundation for the whole exercise. In my opinion, the data on population status may not be entirely accurate, in some cases particularly for the 'Crest line' and 'Malnad' regions. This has led to some errors in the occurrence ratings. For example the herbivores except the elephants are certainly more abundant in the 'Crest line' region between Kollur and Charmadi rather than between Charmadi and Mercara as shown in the paper.

4. I am comparing below the information I have obtained during my field investigations with those of the paper. In the Mysore plateau, Crest line, and Malnad regions I have indicated the current population status of various mammals, which I feel is more accurate. Also I have added some information on some additional mammals and areas excluded from the paper. The notations used are the same as in the paper; 0 = absent, 4 = very common, 3 = frequent, 2 = present, 1 = rare, and - = no information. The figures indicated in brackets are from the paper.

4.1 **Elephant**: In the 'Crest line' region their status is; Byndoor range —0 (1), Coondapur range —0 (1), Periyapatna range 1 (—). There seems to be a curious 'gap' in their distribution between 'Charmadi' and Kollur in the western ghats. Superficially there does not seem to be any ecological reason for this 'Elephant gap'.

4.2 **Gaur**: Their population status in some of the ranges is Byndoor 2 (—), Shankaranarayana 2 (1), Hebri 2 (1), Karkala 2 (1), Agumbe 2 (1) and Periyapatna 1 (—). It is a curious fact that they seem to be raiding crops only in some parts of their range like South Kanara District but not in Muthodi and Lakkavalli.

4.3 Spotted Deer : Their status is Periyapatna 1 (—), Hunsur 1 (—). It is remarkable that these Deer which are normally inhabitants of dry/moist deciduous forests have adapted to the evergreen forest/shola type of mountain biome to the east of Kudremukh mines where a few survive. This is perhaps the only region in south-India where they have adapted to such a habitat.

4.4 Sambar : They are present in many of the 'Crest line' ranges and I feel their status may be as below : Byndoor 2 (1), Shankaranarayana 2 (0), Hebri 1 (0), Karkala 2 (1), Periyapatna 1 (—) and Tarikere 1 (—).

4.5 Barking Deer : These appear to be ecologically, the most adaptive species of Deer and thrive in all habitats except the dry scrub of the plains. Where given protection they seem to increase rapidly like the spotted deer and lose some of their shyness.

4.6 Four horned Antelope : I have heard of them reported from Sunkadakatte, A. M. Gudi and Begur areas (Mysore plateau), Kanakapura (Kollegal Hills). They formerly existed in Bhadravathi and Kadur of Malnad region where their current status is unknown.

4.7 Blackbuck : They are reported from Ranibennur and parts of Raichur and Gulbarga districts. They also probably occur as scattered remnant populations in the arid parts of Bellary, Mandya, Hassan and Mysore districts.

4.8 Chinkara : These are sporadically found along with Blackbuck populations. They are reported from Dharwar and Gulbarga districts. I have seen a captive specimen recently obtained in Dharwar district.

4.9 Nilgai : I have not heard of this antelope reported from anywhere in Karnataka recently.

4.10 Nilgiri Tahr : I have never seen or heard of these animals from Karnataka. Even the old British District Gazetteers from this area or old Shikar accounts do not mention them as far as I know. However Davidar (*JBNHS* 75, No. 3) mentions a source who claims to have seen them in Agumbe in 1954. This seems rather curious.

4.11 Wild Pig : Since the wild pig is so ubiquitous it probably occurs in Manchikere and Anekal ranges also.

4.12 Tiger : These sporadically occur in Byndoor 1 (0) and Periyapatna 1 (—) ranges. Recently a case of tiger poaching was detected in Periyapatna.

4.13 Panther : I have personally seen panthers in Byndoor and Lakkavalli ranges. Their status is Byndoor 1 (0), Lakkavalli 1 (0), Hosnagara 1 (0), Agumbe 1 (0), Hebri 1 (0), Periyapatna 1 (—). They perhaps occur in many other ranges.

4.14 Sloth Bear : They occur in all the six regions. I have seen them in Nagarhole. They have been reported from Lakkavalli, Mudigere, Muthodi, Kudremukh, Sirsi, B.R. Hills and parts of Chitradurga and Tumkur districts.

4.15 Striped Hyena : Once common all over the state, they are apparently becoming scarce everywhere. I have seen their tracks in Nagarhole, Muthodi and Periyapatna ranges and have heard them reported from H. D. Kote, Bandipur and Kadur areas. A few years ago they were very common in the coastal districts.

4.16 Wolf : Though becoming rare, wolves are still occasionally reported from the plains. They occur in Ranebennur, Chittapur (Gulbarga district), Nagamangala and other dry tracts of Mandya district and K. R. Nagar taluk of Mysore district. I have seen the fresh carcase of a wolf run over by a truck near 'Arabithittu' in Hunsur forest range.

4.17 Wild Dog: These do occur at the foot of the western ghats in South Kanara district where I have seen their tracks in most of the jungles. Their population status probably is; Periyapatna 1 (—), Karkala 2 (0), Shankaranarayana 2 (0).

5. On the whole, in spite of some minor errors, this paper is a welcome attempt at systematically examining the distribution of wild mammals over a large region and will serve as a good basis for future localised studies in Karnataka.

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9. BLACK-EARED KITE [*MILVUS MIGRANS LINEATUS* (GRAY)] NEAR BOMBAY

The Black-eared or Large Indian Kite [*Milvus migrans lineatus* (Gray)] is well known as a winter migrant to the Indian continent as far south as the Shimoga District, Mysore but most of the records are of single birds. On 22nd March 1981, one of us (H.A.) visited the Deonar Garbage Dumping Ground (with Mrs. Phillippa Mukherjee) and saw several of these kites on the rubbish dumps. When seated, the black patch behind the ear, and the tuft of long loose feathers projecting below the tibio-tarsal joint were distinctive while in flight the rectangular patch of white on the underwing showed prominently.

Yesterday (about 8.30 a.m.) we were driving eastwards off Trombay Bridge when we saw a number of birds of prey circling high overhead. We stopped to glass them and counted 35 of these kites, whose size and colour could be compared with local pariah kites flying lower and nearer.

There does not appear to be any record of such congregation of this species and which is possibly prior to migration. Similar behaviour has been noticed in gulls in Bombay, but in the evenings.

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10. NESTING OF REDHEADED MERLIN (*FALCO CHICQUERA* DAUDIN) IN BANGALORE, KARNATAKA

(*With a text-figure*)

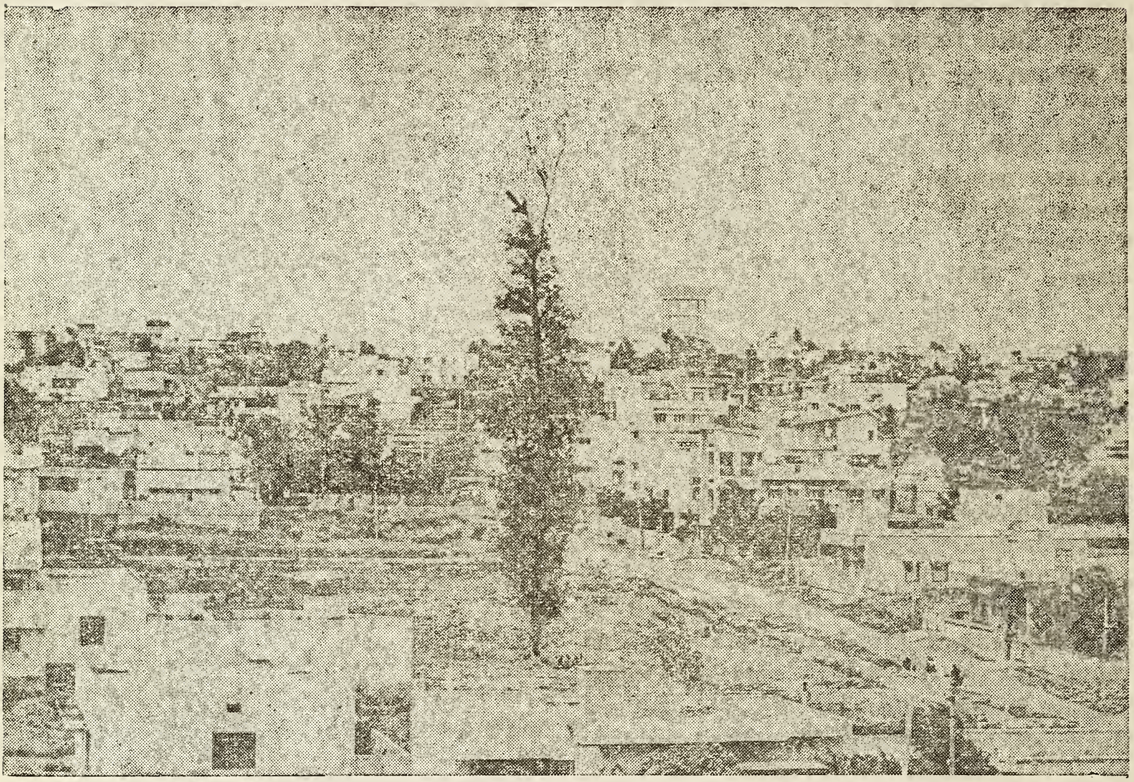

Fig. 1. The nesting site of Redheaded Merlin in Bangalore. Arrow indicates position of the nest.

The distribution of the Redheaded Merlin is not clear in South India (Ali and Ripley 1968, Brown and Amadon 1968). Though there is a sight-record of this bird in Bangalore (Govindakrishnan *et al.* 1977), its exact status is not known. In this context, the present nesting records of this bird for two successive seasons in Bangalore is of interest and confirms its status as 'resident' here.

A pair of this bird was sighted nesting in Rajajinagar (Bangalore City) which, by the first week of March 1979 raised a brood of three. Further, the adult birds were observed through the breeding season of 1979-80 and by the third week of March 1980, four fledglings were out of the nest.

The nest occupied by the merlins in 1978-79 was a sunken platform of twigs built in a fork of a *Casuarina equisetifolia* tree (*c.*80 ft. high) while in 1979-80 they took over a similar freshly built nest of a Jungle Crow (*Corvus macrorhynchos*), situated two feet away and one foot above the previous nest, again in a fork. Both the nests were surrounded completely by small branches arising from the branches that formed the forks in which the nests were built. Records of falcons occupying the nests of other birds that have similar nesting site requirements do exist in literature (see Bent 1938; pp. 21-22, 96, 102). Hence, the present observation further confirms the lack of nest-building instinct in falcons (Brown and Amadon 1968).

The lone tree is situated in a small open land amidst an urbanised residential area (see fig. 1). This seems to be interesting in view of the earlier records (Ali and Ripley 1968, Brown and Amadon 1968, Ganguly 1975), where the redheaded merlin is recorded to be a bird of open country and rural areas. However, falcons being attracted to an urban set up is not unusual. An instance is seen in the case of a Peregrine Falcon, *Falco peregrinus* which selected a busy city as its nesting habitat instead of eyeries, in the wild (Welty 1975). The observations of Dharap (1977) and Gole (1979) seem to support the present observation where a pair of redheaded merlin was seen nesting on a 100 ft. building in Poona, Maharashtra.

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11. UNUSUAL NESTING OF REDWATTLED LAPWING (*VANELLUS INDICUS*)

Behind our house in Panchwati at Udaipur there is a three storeyed building belonging to a school. The roof of this building is of asbestos cement sheets. Two Redwattled lapwing (*Vanellus indicus*) were usually seen perched atop this roof at the beginning of May protesting and attacking birds of prey.

In the morning of 14th May, 1981 we saw one of the lapwings with four chicks at the edge of the roof. For five days we saw these chicks frequently with the lapwing at the edge of the roof. On the 6th day two chicks fell down from the roof and died; on the 10th day the other two landed safely on the ground.

Near our house there are barren grounds as well as a deep and dry nullah over 100 feet wide and 10 ft. deep. The walls of the nullah are quite high and men seldom venture inside it. Inspite of all these safe grounds and flat roofed buildings being available why this pair of lapwings chose the sloping and uneven roof of the school building for nesting is a puzzle. Though there, are some stray dogs and domestic cats in the vicinity the nearby nullah is not visited by any of these predators and is certainly safer than the roof.

41, Panchwati, Udaipur,
Rajasthan,
June 19, 1981.

RAZA H. TEHSIN
JUZER LOKHANDWALA

12. COLLECTIVE DEFENSIVE STRATEGY IN BLUE ROCK PIGEON (*COLUMBA LIVIA*)

About 40 km from Udaipur there is a township called Gogunda. On the outskirts of this township and near the bus stand, there is a slight slope on the road which is followed by 200 metres of straight road, on both sides of which there are big trees. From this vantage point near the bus stand I was watching a crested hawk-eagle (*Spizaetus cirrhatus*) circling clockwise in the sky. As it neared the treetops about 35 blue rock pigeon (*Columba livia*) took fright and flew away. Then the flock turned and started circling anti-clockwise on the same plane as that of crested hawk-eagle. The eagle widened its circles and started gaining height. The pigeons followed suit. When they crossed each other some pigeons brushed past the eagle and sometimes they flew so threateningly that the eagle had to change its course to avoid head-on collision. This went on for about 10 minutes during which the birds reached very high altitudes and their circles widened further. At this point when the eagle and pigeons were farthest apart in the circle the pigeons dropped vertically towards the ground and within no time settled on the trees having eluded the predator.

41, Panchwati,
Udaipur-313 001.
June 19, 1981.

RAZA H. TEHSIN

13. OCCURRENCE OF THE NORTHERN GREEN BARBET *MEGALAIMA ZEYLANICA CANICEPS* (FRANKLIN) AT LUDHIANA (PUNJAB)

A female Northern Green Barbet *Megalaima zeylanica caniceps* (Franklin) was collected from a *neem* tree in the Punjab Agricultural University Campus, Ludhiana (30° 56′ N, 75° 52′ E) on 10 May 1981. The weight and measurements of the specimen were as follows:

	Weight	Wing	Bill (*from skull*)	Tarsus	Tail
1♀	132 *g*	131 mm	35.5 mm	32 mm	84 mm

These measurements are in general agreement with those already reported for this species by Ali and Ripley (1970) and Abdulali (1974).

According to Ali and Ripley (1970) this species is distributed in: 'The lower western Himalayas (up to *c.* 800 m) from Kangra in Himachal Pradesh to Kumaon (U.P.) and western Nepal terai (to *c.* 300 m). Continental India west to Mt. Abu and Gujarat, east through Madhya Pradesh and northern Maharashtra to Bihar, W. Bengal (straggling as far as Calcutta), and Orissa south to Godavari R. .... conspicuously common and abundant in New Delhi'. In the Punjab, this species has been reported to occur only in the district of Hoshiarpur (Sharma and Lamba 1954) most of which is submontane area and there has been no record of this bird from any other region of the state. The present record, therefore, adds Ludhiana to the range of the Northern Green Barbet.

Department of Zoology,
Punjab Agricultural University,
Ludhiana-141 004,
Punjab,
May 16, 1981.

MANJIT S. DHINDSA
P. S. SANDHU

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14. ON THE OCCURRENCE OF THE YELLOWBELLIED WREN-WARBLER (*PRINIA FLAVIVENTRIS FLAVIVENTRIS*), STRIATED MARSH WARBLER (*MEGALURUS PALUSTRIS*) AND WHITETAILED BUSH CHAT (*SAXICOLA LEUCURA*) AT HASTINAPUR NEAR MEERUT (UTTAR PRADESH)

Over the last two years of bird study at and around Hastinapur, 30 km. north-west of Meerut, U.P., I have come across some birds which do not appear to have been recorded in this area :—

(*a*) 1525 [1] — Yellowbellied Wren-Warbler (*Prinia flaviventris*)

This can be heard everywhere throughout the year and more easily seen from March to September.

(*b*) 1548 — Striated Marsh Warbler (*Megalurus palustris*)

Its distinctive flight and song, high up in the air and when dropping earthwards, are most noticeable in February and March.

(*c*) 1699 — Whitetailed Bush Chat *Saxicola leucura* (Blyth)

This was first seen in June 1979 and mistaken for a Collared Bush Chat (*Saxicola torquata*) overstaying into summer. I wrote to Mr. Humayun Abdulali and upon his expressing a doubt regarding the identity of the species, a specimen was collected and found to be of this species. The bird is resident and parties of juveniles in various plumages, always three together, were often seen and were probably all of the same brood.

Hastinapur is an extensive area of marshland and in the riverain tract of Boorhi Ganga running north to south for about 35 km. The area is flooded during the monsoon but retains water throughout the year, being overgrown with *Typha elephantina*, *Coix lachrymajobi*, *Phragmites karka*, and other grasses and herbs.

I am grateful to Mr. Humayun Abdulali whose advice and incentive prompted me to obtain specimens of all three species and have them identified at the Bombay Natural History Society.

All three species which are missing from the Checklist of the Birds of Delhi, Agra and Bharatpur, have been recorded from Delhi by Mr. Sudhir Vyas (Newsletter for Birdwatchers, vol. XIX, No. 11, pp. 2-5).

414, Western Kutchery Road,
Meerut-250 001, (U.P.),
May 25, 1981.

YADO MOHAN RAI

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[1] Handbook Vol. 8.

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15. BIRDS AND STANDING CROPS

Birds are friends of the farmer and not foes, says Dr. Sálim Ali[1] mainly because they destroy insects that plague his crops. Farmers, who spend hours in driving the flocks of birds away from their crop, may not agree. Yet it is doubtful how many of them precisely know which birds are destructive and which are not and how much damage the destructive species inflict on the crop. To observe which birds come to the standing crop and what exactly they do once they alight in the fields, 20 consecutive mornings were spent in October 1979 in a group of cultivated plots which were mostly left unguarded.

The cultivated fields measured roughly 120′ × 50′ each. Two were adjacent divided only by a track, while the third was about a furlong away. The standing crop in all of them was *jowar* in various stages of ripening. Some cobs had very tender grain while in others grains were ripe and hardened. Out of the two adjacent fields, crop in one was cut after it had been observed for 4 days. The third field, though unguarded, had the farmer's cottage situated close by, and there was always some movement of men and animals around. While this discouraged certain species who otherwise would have come into the field, the farming operations and fallen grain around the hut, had attracted a flock of about 100 house sparrows who seemed to have taken a permanent residence there. As this tended to give a certain bias to observations, after the first 4 days, observations were concentrated in the remaining field which was totally unguarded and absolutely without any human interference during the observation period.

Observations were recorded during a one-and-half hour period between 7 and 9 a.m. Fields were also visited in the evening between 4 and 5 p.m. to record the evening activity of birds. A field, roughly of the same size but about 10 km away in the opposite direction, was also visited thrice in the morning to see if the number and variety of species differed markedly here from those in the fields under closer security. No such difference was noticed.

Except for three mornings, the sky remained cloudy during the period of observation. But there was some westerly breeze and the sun used to come out a little after 8 a.m. Evenings were sunny with a stronger breeze. During the observation period temperature varied between 18°.8′ and 32°.7′C. Most of the observations were recorded by going round the periphery of the fields. But sometimes it became necessary to enter the standing crops to observe bird activity at there base or about a foot above ground.

A total of 732 individuals belonging to 34 different species came to the fields during the period of observation. The total of course includes the flock of about 100 house sparrows and birds such as a black-winged kite, a pair of red-headed merlins, a white-eyed buzzard-eagle sand martins and common, red-rumped and wire-tailed swallows that either hovered or flew over the fields. Every day the number of species visiting the fields varied between 18 and 26 with the total number of individuals varying between 75 to 165. But when observations were concentrated on the single field, the number of species per day (during observation period) varied between 7 and 15 and the number of individuals between 24 and 58.

Out of the total of 34 species observed, 13 are known to eat grain, and out of these, eight species were actually seen plucking out and eating grains from the cobs. These 8 species were : house sparrow, common rosefinch, baya weaver, redvented bulbul, common myna, and whitethroated, spotted and blackthroated munias. The munias attacked mainly cobs with very tender grain, otherwise they tended to eat grass and weed seeds by alighting at the foot of the standing crop. To a smaller extent rosefinches and bayas also were attracted to tender grain or searched for insects on the ground. House sparrows, redvented bulbuls and common mynas ate even hardened grain. At one time a house sparrow or a baya would eat a maximum of 14 grains each ; a bulbul and a rosefinch would eat 20 grains each, while a myna would take a maximum of 40 grains at one sitting. Normally however, munias, bayas and house sparrows would take 3-4, bulbuls, rosefinches 7-8 and mynas 13-14 grains each at one time.

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[1] ALI, SALIM (1972): The Book of Indian Birds, IXth Edition, Bombay Natural History Society, Bombay, pp. 152-153.

Blackheaded bunting, house and jungle crows, blue rock pigeon and yellowthroated sparrow are also known to eat grain but were not observed doing so. The remaining 21 species are known to be insect or flesh-eaters and came to the fields in search of these. If the 3 birds of prey and 3 species of swallow who never alighted in the fields, are excluded, 15 species of insectivorous birds were seen to alight in the fields. Out of these 15, six were actually seen to catch and eat insects and other animal food. These 6 species were : rufousbacked shrike, common green bee-eater, piedcrested cuckoo, collared bush chat, ashy wren-warbler and Blyth's reed warbler. Other insectivorous birds included : Indian wren-warbler, black and white-bellied drongos, Indian roller, Indian pipit, Indian robin and yellow wagtail etc.

While each flock of grain-eaters did not remain in the field for more than ten minutes, the insectivorous birds tended to spend all the time in the field in question. Indeed there is reason to believe that more than half of these species even roosted in the field and for all practical purposes never left the field during the day. While everyone of the insectivorous birds was on the lookout for insects while in the field, not every individual from the graminivorous flocks would eat grain while in the field.

The number of graminivorous species visiting the field every day was only 3 or 4. These birds normally came into the fields in flocks of 3-4 to 10-12 individuals. But the number of individuals actually eating grain would be only 1-2 to 5-6 from each flock. Some of the individuals would dive down at the base of the crop among grasses and weeds for seeds and insects. The insectivorous birds came as individuals but spent almost all the time in the field. Even from the large flock of about 100 house sparrows only 30-45 were observed eating grains, the others simply indulged in chirping or preening.

What do these short observations indicate ? It appears that the majority of birds that come to the fields and spend most of their time there, are insect-eaters. The grain-eaters are fewer in numbers, spend less time in the field and even lesser time actually consuming the crop. Some of them even search for insects and remove weed seeds, activities beneficial to the farmer. While it may not be true to say that the quantity of insects removed by insectivorous birds is greater than the quantity of grain eaten by grain-eaters, in terms of value, the former may be doing a greater service to the cultivator than the amount of damage inflicted by the latter. Of course, the real damage can only be assessed by comparing the value of harvest from fields that are closely guarded and that are not guarded at all. On the basis of the present observations one may say that the actual conditions approximate more to Dr. Sálim Ali's statement than to the prevalent view of the farmers.

BIRDS THAT CAME TO THE FIELDS WITH STANDING CROPS

Birds that ate grain :

1. Common Myna (*Acridotheres tristis*)
2. Redvented Bulbul (*Pycnonotus cafer*)
3. House Sparrow (*Passer domesticus*)
4. Baya Weaver (*Ploceus philippinus*)
5. Whitethroated Munia (*Lonchura malabarica*)
6. Spotted Munia (*Lonchura punctulata*)
7. Blackheaded Munia (*Lonchura malacca*)
8. Common Rosefinch (*Carpodacus erythrinus*)

Other grain-eaters :

9. Blue Rock Pigeon (*Columba livia*)
10. House Crow (*Corvus splendens*)
11. Jungle Crow (*Corvus macrorhynchos*)
12. Yellowthroated Sparrow (*Petronia xanthocollis*)
13. Blackheaded Bunting (*Emberiza melanocephala*)

Birds that ate insects or other animal matter :

14. Pied Crested Cuckoo (*Clamator jacobinus*)
15. Green Bee-eater (*Merops orientalis*)
16. Rufousbacked Shrike (*Lanius schach*)
17. Ashy Wren-Warbler (*Prinia socialis*)
18. Blyth's Reed Warbler (*Acrocephalus dumetorum*)
19. Collared Bushchat or Stonechat (*Saxicola torquata*)

Other insect-eaters :

20. Redwattled Lapwing (*Vanellus indicus*)
21. Indian Roller (*Coracias benghalensis*)
22. Black Drongo (*Dicrurus adsimilis*)
23. Whitebellied Drongo (*Dicrurus caerulescens*)
24. Indian Wren-Warbler (*Prinia subflava*)
25. Booted Warbler (*Hippolais caligata*)
26. Indian Robin (*Saxicoloides fulicata*)
27. Brown Rock Pipit (*Anthus similis*)
28. Yellow Wagtail (*Motacilla flava*)

Birds of Prey :

29. Blackwinged Kite (*Elanus caeruleus*)
30. White-eyed Buzzard-eagle (*Butastur teesa*)
31. Redheaded Merlin (*Falco chicquera*)

Birds that hawked insects over the fields :

32. Plain Sand Martin (*Riparia paludicola*)
33. Eastern Swallow (*Hirundo rustica*)
34. Redrumped Swallow (*Hirundo daurica*)

277, SINDH HOUSING SOCIETY,
POONA-411 007.
April 2, 1981.

PRAKASH GOLE

16. FEMALE TERRITORIALITY IN IMMATURE SALTWATER CROCODILES *CROCODYLUS POROSUS* SCHNEIDER IN CAPTIVITY AND ITS EFFECT ON GROWTH & SURVIVAL

(*With two text- figures*)

INTRODUCTION AND METHODS

Bustard and Kar (1980) demonstrated the development of territoriality in immature saltwater crocodiles in their third year kept in 4 × 4 × 1 m pools.

A group of seven juveniles, comprising three females hatched in August 1975 and two males and two females hatched in August 1976 all at the Saltwater Crocodile Centre, Dangmal, Orissa, were brought to a specially-constructed saltwater crocodile breeding pool in Nandankanan Biological Park, Orissa on 22nd February 1978 when the two age groups were 30 and 18 months old respectively. It was proposed to rear these individuals as a breeding group, if necessary removing the second male at a later stage.

The breeding pool (Figure 1) has a maximum length of 53.4 m with a maximum breadth of 41.6 m. The pool slopes gradually from the edge to a maximum depth of 2 m. The water space is 620^2m and the pool can hold approximately 6,20,000 litres. Two islands occur within the pool but these are rocky and merely serve to break up the configuration of the pool. They cannot be used for nesting or basking purposes. The pool is surrounded by a brick and mortar, cement-plastered, wall 2 m in height.

Food consisted both of fish, fed live, and beef. Fish were released into the pool and beef was chopped and placed on seven stone feeding slabs placed around the perimeter of the pool.

Daily observations were made on the behaviour of the crocodiles and periodically the group was caught and size and weights recorded.

RESULTS

At the start, on 22nd February 1978 females C, D and E, all of the 1975 year class, were of a similar size although E was slightly heavier than the other two females. The other four

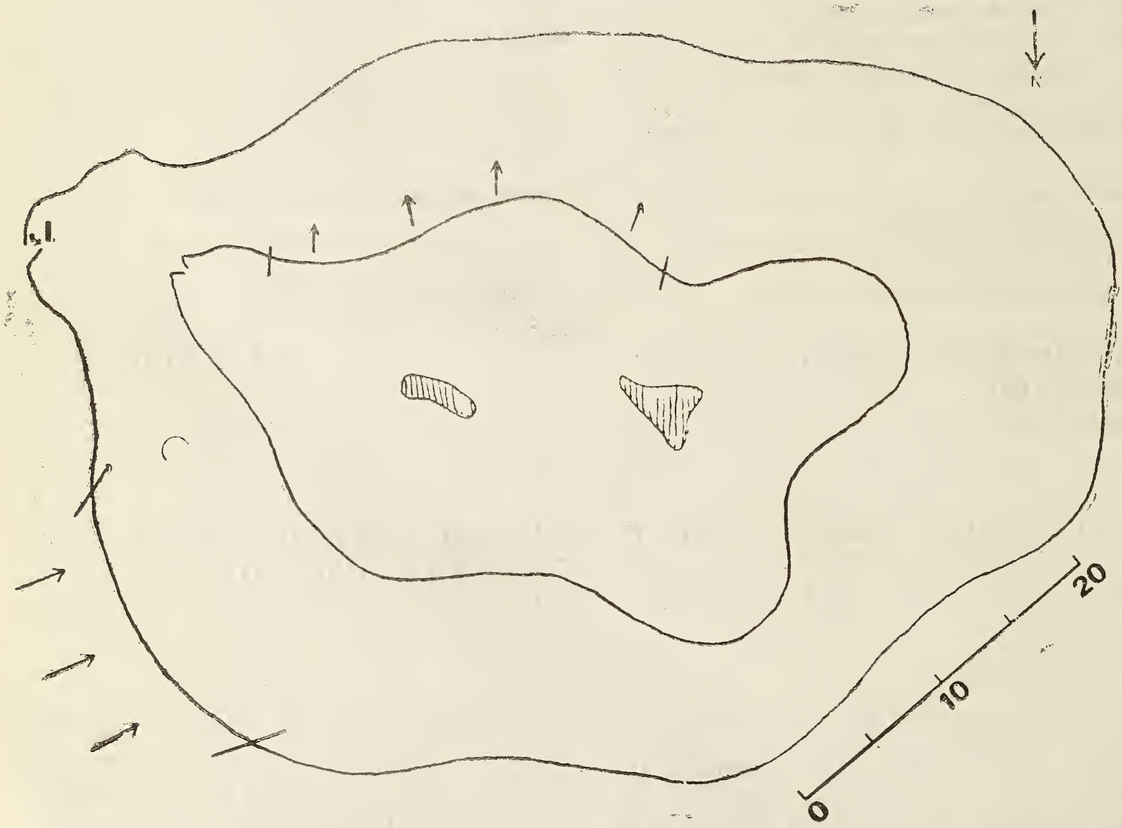

Fig. 1. Saltwater crocodile breeding pool, scale in metres. The arrowed portion of the compound wall is the total viewing area for the public the inner continuous line the perimeter of the pool and the cross-hatched areas are rocky islands within the pool.

Abbreviations: I—Inlet; OF—Overflow used to regularly inundate an area of land to the rear of the pool and make it marshy.

individuals, of the 1976 year class, comprising two of each sex, were also similar to each other.

Conflict resulting from a dominant female, commenced 3-4 days after the crocodiles were put into the breeding pool.

Female F and male G were badly victimised by the dominant female and died on 20-7-78 and 24-7-78 respectively as a result of failure to realise how badly persecuted they were. The persecution took the form of chasing and biting these individuals which became too frightened to enter the pool and remained under bushes well back from the perimeter of the pool.

On 26-8-78 the remaining male (A) was removed to an enclosure measuring 6 × 4.5 m with a pool of 1.64 × 0.4 × 0.3 m deep.

By 6-1-79 female E had become so dominant that attempts to continue to rear the group in the large breeding pool were terminated. Female E was moved to an enclosure measuring 7.0 × 4.7 m with a pool of 2.8 × 0.4 m deep. B, C and D were released in a crocodile enclosure measuring 24 × 14.4 m with a pool of 13.7 × 6 × 0.9 m deep.

Records on the seven individuals are summarised in Table 1.

On 23-2-79, B was separated from C and D as it was very much smaller in length and much lighter in weight (Table 1) (the period 6-1-79 to 23-2-79 is cool winter weather when feeding is minimal).

The effects of territoriality between B, C and D on their growth, both of length and of weight, are shown graphically for the period 23-2-79 to 29-9-79 in Figure 2. The very rapid increase in the weight and length of the dominant (D) is apparent during both summer and monsoon seasons 1979. By 12-10-79 D had more than doubled its weight to 21.6 kg from 10.2 kg as compared to 23-2-79. During the same period — covering summer and monsoon seasons— B had also shown excellent growth more than doubling its weight from 4.0 to 8.6 kg and increasing its length by approximately 40% from 103 to 142 cm. But female C, which was now dominated by female D had shown scarcely any increase in length or weight. Female C was removed on 12-10-79 and left with B.

Female C on its removal to the enclosure of B did not show any significant growth and became dominated to some extent by B which had formerly been considerably smaller (Figure 2). Female C subsequently entered the pool of D on 15-7-80 through a gap in the partition and as a result of attacks by D, died on 29-9-80. B again showed good growth during the 1980 growing season.

DISCUSSION

The level of territoriality shown by females E and D, and to a lesser extent by B towards C and other members of the group, are likely in the wild to be translated into spacing out of individuals throughout the available habitat. The prognosis for smaller, socially inferior, individuals is extremely bleak, not only as a result of actual damage sustained as a result of attacks by the dominant territory holder, but as a result of constant suppression of growth. In the wild animals unable to secure a territory will be lost from the population through death, a result postulated for the geckos studied by Bustard (1969) in the wild which were unable to secure a territory.

While victimisation of small crocodiles by a dominant is well known (Bustard 1975) the delity effects of this on vigorous larger individuals—leading to their death—should be noted. Had C been left alone and suitably

TABLE 1

EFFECT OF SOCIAL HIERARCHY ON GROWTH AND SURVIVAL

Sex	Male A	Female B	Female C	Female D	Female E	Female F	Male G
Year of hatching	1976	1976	1975	1975	1975	1976	1976
22.7.78							
(*a*) Total length in cm.	96.2	88.9	116.8	116.8	121.9	91.4	91.4
(*b*) Weight in kgs	2.7	2.9	4.5	4.5	6.3	2.5	2.5
20.7.78****							
(*a*) Total length	..	..	..	..	..	88.0	94.0
(*b*) Weight	..	..	..	..	..	2.0	1.6
6.1.79*							
(*a*) Total length	121.0	102.0	131.0	136.0	165.0	..	..
(*b*) Weight	6.6	4.4	9.0	10.1	17.0	..	..
23.2.79**							
(*a*) Total length	123.0	103.0	131.0	138.0	168.0	..	..
(*b*) Weight	6.6	4.0	8.6	10.2	19.0	..	..
12.10.79							
(*a*) Total length	128.0	142.0	133.0	177.0	198.0	..	..
(*b*) Weight	8.0	8.6	9.2	21.6	28.6	..	..
12.12.79***							
(*a*) Total length	129.0	142.0	134.0.	178.0	200.0	..	..
(*b*) Weight	7.4	10.4	9.6	22.0	29.4	..	..
5.1.80							
(*a*) Total length	129.0	142.0	134.0	181.0	201.0	..	..
(*b*) Weight	7.6	11.0	9.8	24.0	32.8	..	..
26.2.80							
(*a*) Total length	125.0	..	..	..	..	..	..
(*b*) Weight	6.0	..	..	..	..	..	..
28.2.80							
(*a*) Total length	..	142.0	139.0	185.0	202.0	..	..
(*b*) Weight	..	11.6	9.4	26.6	34.0	..	..
28.9.80							
(*a*) Total length	..	..	140.0	..	..	..	..
(*b*) Weight	..	..	10.4	..	..	..	..
29.9.80							
(*a*) Total length	..	176.0	..	215.0	228.0	..	..
(*b*) Weight	..	19.3	..	36.9	44.8	..	..
Approx. Age	..	5 years	..	5 years	5 years	..	..

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* Female E was transferred to a separate pool, B, C, and D were also transferred from the breeding pool to a smaller pool.

** Male A was transferred to a separate pool on 26.8.78 and died in this pool on 26.2.80.

*** Female C was removed from D and accommodated with B on 12.10.79.

**** Female F and male G died on 20.7.78 and 24.7.78 respectively.

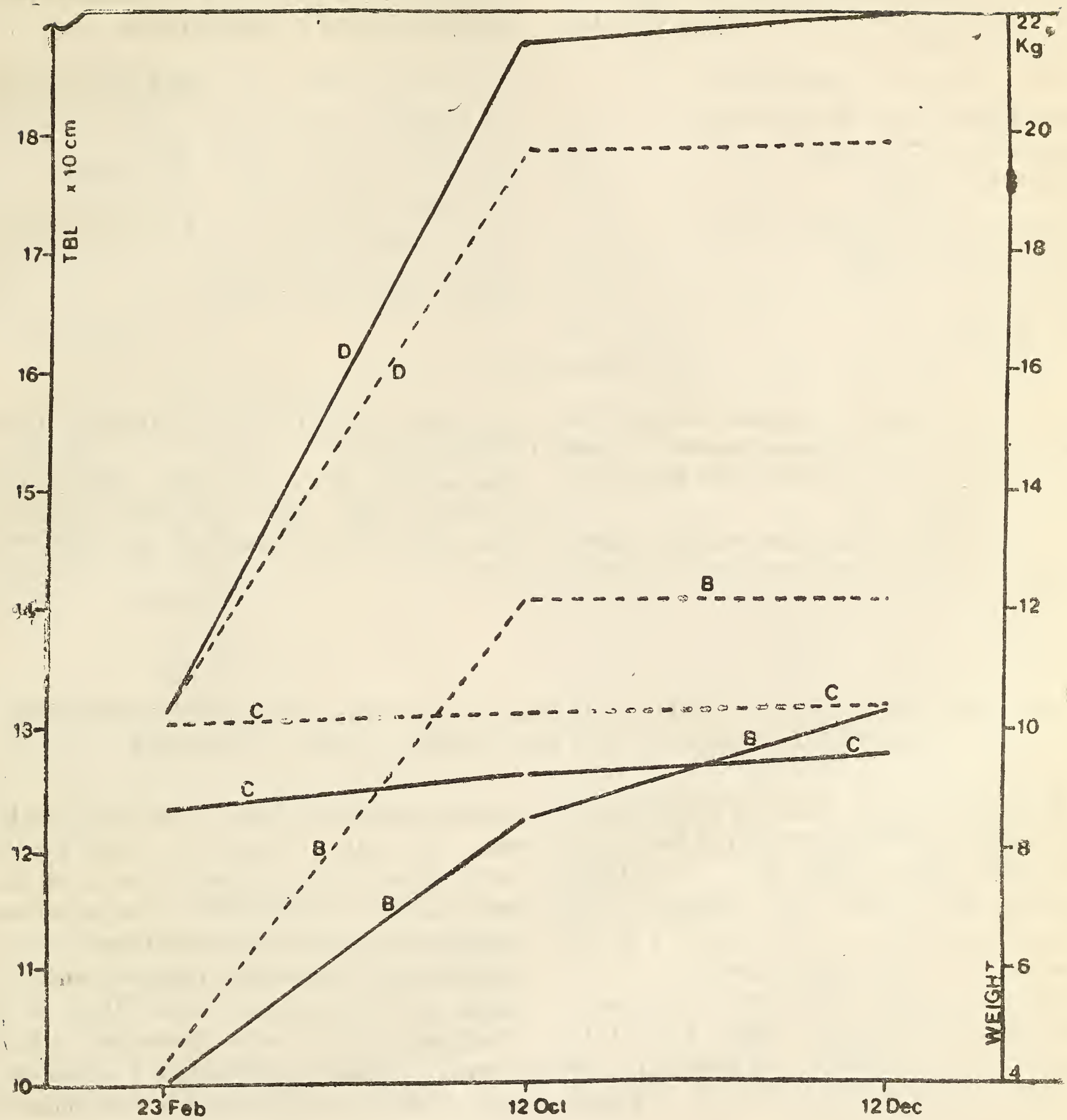

Fig. 2. The effect of status on growth. All individuals and females length (cm) and weights (kg). The figure shows very rapid growth of a dominant (D), virtually zero growth of a suppressed individual (C) housed with the dominant, and rapid growth of B removed from the presence of the dominant. B is one year younger than C but as a result of suppression of growth in C, B overtook it, both in length and weight, by 12-12-79, at an age of 3½ years as compared to C's 4½ years. These differences are entirely a result of dominance effects.

housed it would have resumed good growth exactly as had occurred in the case of B. The failure to remove this individual from the enclosure of B had the same effect as one would expect in nature as a result of an individual not being able to locate a vacant territory.

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June 23, 1981.

S. MAHARANA

REFERENCE

BUSTARD, H. R. (1969) : The population ecology of the gekkonid lizard [*Gehyra variegata* (Dumèril & Bibron)] in exploited forests in northern New South Wales. *J. Anim. Ecol.* 38 : 35-51.

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BUSTARD, H. R. & KAR S. K. (1980) : Territoriality in immature captive saltwater crocodiles (*Crocodylus porosus*, Schneider). *J. Bombay nat. Hist. Soc.* **77** : 148-149.

17. THE EXTINCTION OF THE GHARIAL [*GAVIALIS GANGETICUS* (GMELIN)] FROM THE BRAHMANI AND BAITARANI RIVERS OF ORISSA

The gharial formerly inhabited all three major river systems of Orissa (Singh and Bustard, in press). Critically-endangered population remnants still inhabit the Mahanadi river (Bustard and Singh, in prepn.) where a special sanctuary has been created and an extensive gharial conservation programme is in operation (FAO 1974, Bustard 1975, FAO 1975, Bustard 1976). However, the species is now considered to be extinct in both the Brahmani and Baitarani river systems.

Details of these extinctions are set out below :

BRAHMANI RIVER

Until about 10-15 years ago gharial occurred in the Brahmani river at Bonaigarh, Talcher, Kamakshyanagar and also in the lower Brahmani. The Raja of Sundargarh killed a male gharial about 22 ft. (6.6 m) in length in the Brahmani near Bonai in 1967. The informant further indicated that since 1970 there are no further reports concerning the occurrence of gharial in the Brahmani river. There is a village near Talcher called Katarapada where the river is called Kumbhirakhai (=crocodile eating place in Oriya) because a large number of gharial occurred in this area until twenty years ago. A dam is being constructed about 20 miles upstream from Talcher. It is reported that when the site for the construction of the dam was selected and extensive dynamiting took place in the area, many gharial were killed.

A person from outside of Orissa killed a gharial in the Brahmani in 1975. This was probably the last surviving Brahmani gharial.

Two tributaries of the Brahmani formerly holding gharial were the rivers Kharasuan and Ramiyala. Many gharial formerly inhabited the Sundarmundi Gorge of the Ramiyala river. The practice of dynamiting for fish is reported to have killed many gharial. The last definite report from Ramiyala was during 1958 when two gharial were killed by this fishing practice.

BAITARANI RIVER

Gharial were formerly present in the lower Baitarani and near Anandpur and Jajpur areas (Singh and Bustard, in press). However, there are no reports for the last 10-20 years and we consider that the gharial is now definitely extinct in the Baitarani river.

SILERU RIVER

The Sileru river joins the Godavari which flows into Andhra Pradesh. There are reports of the occurrence of gharial in the Sileru up to 1971. We feel that the gharial is now extinct in the Sileru.

DISCUSSION

The above account documents how rapidly the gharial has been lost from most of its former habitat in Orissa, a process which has been repeated throughout most of the gharial's former range. We cannot pinpoint the precise time when the gharial became extinct in the Baitarani but consider that this occurred during the 1960's. For the Sileru it was in the early 1970's (last report 1971) and for the Brahmani it was as recent as 1975.

The significant point is that the rapid disappearance of these entire populations occurred without the knowledge of responsible people at the time. This is exactly how an entire species can be lost, and the extinction of the Indian Cheetah provides a graphic example. A species becomes rare, it is seldom sighted, and amid apathy, or lack of clear understanding of what requires to be done, may entirely disappear.

The Indian Gharial is a species which has been saved from the brink. We feel certain that the Mahanadi gharial population would already have gone the way of those of the Baitarani, Sileru and Brahmani, and hence the gharial would have become extinct in Orissa, and in due course throughout India, had it not been for the concern of the Government of India for the species leading to an investigation into its status and conservation requirements (FAO 1974). Following submission of this report to Government of India, extremely rapid conservation action to save the gharial was initiated by the Government of India, in association with the States, under technical assistance from FAO/UNDP (FAO, 1975). This work is continuing.

ACKNOWLEDGEMENTS

We wish to express our thanks to Orissa Forest Department, Government of India, F.A.O. and U.N.D.P. for various help during the study.

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18. A TAXONOMIC NOTE ON MUGGER SUBSPECIES (*CROCODYLUS PALUSTRIS*)

In Deraniyagala's (1936) description of the Sri Lankan subspecies of *Crocodylus palustris* (*C. p. kimbula*) he listed several features which, in his opinion, distinguished it from Indian *C. palustris.*

While examining data collected by C. A. Ross in 1974 on scalation of *C. palustris* specimens from several parts of India and our own captive stock of 1000 at Madras Crocodile Bank we found that the characters given as points of sub-specific differentiation between the Indian and Sri Lankan races of *C. palustris* are invalid. The small size of the sample of Indian specimens Deraniyagala looked at is probably to blame. Of the four characters given by Deraniyagala the only one which is presently a point of distinction is the tendency of some populations of Sri Lankan mugger to frequent saltwater (Whitaker 1979). However mugger were once common in the salt pans of Sind (McCann 1935) so even this feature is not unique to the Sri Lankan mugger. The assertion that the Sri Lankan mugger is more frequently known as a maneater than its northern counterpart could be due to confusion with the often sympatric *Crocodylus porosus.*

Taken one by one, the following are the characters given for *C.p. kimbula* by Deraniyagala, each one followed by our findings with mugger from Tamil Nadu, Karnataka and Uttar Pradesh.

(*a*) Sri Lankan mugger has more transverse dorsal rows with six contiguous scutes than with four while seven is not uncommon and occasionally a row with eight.

(*aa*) In our sample of sixteen (Table 1), twelve specimens had more transverse rows with six than four, three had rows with seven and two with eight.

TABLE 1

DORSAL SCALE ROWS OF INDIAN *Crocodylus palustris*

	4 scuted rows	5 scuted rows	6 scuted rows	7 scuted rows	8 scuted rows
Mettur Dam ..	9	4	6	..	..
„ ..	9	2	7	..	..
„ ..	7	1	8	..	2
„ ..	7	1	10	..	..
Malabar ..	10	5	3	..	..
Ranganthittoo ..	8	1	10	..	..
„ ..	7	3	8	..	..
„ ..	9	3	4	..	..
„ ..	7	2	9	..	..
„ ..	7	1	10	..	..
„ ..	7	2	8	..	1
„ ..	7	1	8	2	..
„ ..	7	1	8	2	..
„ ..	6	1	10	1	..
„ ..	7	2	8	..	..
Uttar Pradesh ..	3	4	6	..	..

(*b*) Dorsal scutes subequal in Sri Lankan mugger; only a few isolated ones enlarged; while in the Indian mugger there are 2 median longitudinal rows of conspicuously widened dorsal scutes.

(*bb*) We found the median longitudinal rows of dorsal scales highly variable in the Indian sample, sometimes subequal, sometimes uniformly larger, smaller or equal in size to the other dorsals.

(*c*) Ventral collar of 'twice as deep' scales in Sri Lankan mugger and none in Indian mugger.

(*cc*) In all of the Indian specimens a collar of enlarged scales is present though often not conspicuous in juveniles.

(*d*) Sri Lankan mugger not uncommon in saltwater.

(*dd*) The mugger in India has been hunted out of most of its original habitat which certainly may have included salt pans and estuarine areas, as reported in Sind.

Conclusion :

The great variation in scalation of local populations of the wide ranging *C. palustris* does not support Deraniyagala's contention that the Sri Lankan race is a separate subspecies. Evidence is presented in Table 1.

ACKNOWLEDGEMENTS

We thank our organizations, the Madras Snake Park Trust and Madras Crocodile Bank Trust for their support of our work. We also thank Shekar Dattatri for reviewing this note.

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ROMULUS WHITAKER
ZAHIDA WHITAKER

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19. THE DISTRIBUTION OF THE GHARIAL

Malcolm Smith (1931) gives the distribution of gharial as :

'The Indus, Ganges, Mahanadi and Brahmaputra Rivers and their tributaries and the Kaladan River, Arakan. Barton (1929) records a specimen shot at the mouth of the Maingtha, a tributary of the Sweli River, Upper Burma; it is the sole record from the Irrawaddy River system.'

Leaving aside the questionable occurrence in Burma, the gharial would appear to have a north Indian distribution in the Indo-Gangetic river systems and their tributaries. The occurrence in Mahanadi, and other rivers in Orissa (Singh and Bustard, in prepn.), appears somewhat anomalous.

During the course of a survey in Godavari River of Andhra Pradesh, information was obtained concerning the previous occurrence of crocodiles, which from their description could only be gharial, in the Godavari. Since they apparently no longer occur there, having been wiped out in the post-Second World War crocodile hunting phase, which all but exterminated the gharial in its north Indian stronghold, it is not possible to further substantiate these reports two of which are presented below :

1. In June 1976, when visiting the trans-Godavari in the region of Papikonda Gorge with Mr. T. V. Subba Rao, Additional Chief Conservator of Forests (1) of the Andhra Pradesh State Forest Department, Mr. Subba Rao gave one of us (H.R.B.) definite information that gharial had been present a decade or more ago in the River Godavari. He stated that he had been told of long-snouted crocodiles by fishermen, the description of which could only apply to gharial. Since the only other crocodilian in this area of Godavari is the Indian mugger — the most short-snouted species of the genus *Crocodylus* — it is not possible that this animal was confused with the gharial.
2. In the winter of 1976 (Nov./Dec.) one of us (B.C.C.) was carrying out a survey of wild mugger (*Crocodylus palustris*) populations on the river Godavari and was likewise informed by fishermen that a crocodilian other than the mugger was formerly present in this River. Once again the descriptions provided by fishermen were of a long snouted crocodile which they drew and from the drawings could be positively identified as the gharial. Report said that it occurred at Gundam but also from Pochampad to Lanjamadugu, a stretch of 250 km. One such informant was Kussappa, son of Bhawani, aged approximately 35 years. He had been operating at Pochampad project for 15 years having originally come from Maharashtra. Kussappa said that the gharial in Godavari grew to a length of 12 to 18 ft. and confirmed seeing them during the early 1960's, evidence which was confirmed by other people. Gharial are reported to have been present in this area of the Godavari up to and including the early 1960's. Thereafter, however, these fishermen reported not having seen gharial.

Wainganga/Pranahita, a tributary of the Godavari originates from almost the same latitude as the Mahanadi River, the southernmost range for the gharial described so far. The records here presented indicate that the recent range of the gharial extended to South India.

In view of the former occurrence of the gharial in the Godavari, their occurrence in Mahanadi and the other river systems of Orissa no longer appears so anomalous.

We would be very interested to hear from readers who have *definite* records of gharial in Andhra Pradesh or in other areas where they are not generally known to have occurred. This information, such as old shikar records, would be very useful, since following the massive hunting of crocodiles, gharial must be expected to be extinct in most peripheral parts of their range. Hence such data cannot be collected today.

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20. A RANGE EXTENSION OF *GEOCHELONE ELONGATA*

Three land tortoises are known from India, *Geochelone elongata, G. elegans* and *G. travancorica. Geochelone elongata* and *G.elegans* are widespread, whereas *G. travancorica* is restricted to the Travancore Hills and the western and eastern slopes of the Ghats (Annandale 1915).

Geochelone elongata has been found in Sal forests from the Jalpaiguri district, W. Bengal, Singbhum district, Bihar (Chaibassa and Chotanagpur), Orissa, Puri district, Simlipal in the Mayurbhanj district of Orissa, India, Bangladesh (Akyab and Chittagong Hill Tracts), Nepal, Burma, Cambodia and Vietnam (Biswas *et al.* 1978). The reference of Biswas *et al.* (1978) to Nepal *G. elongata* came from Smith (1931). An exact locality for Smith's record is unavailable. Apparently, this species is restricted to Sal forests.

In April 1974, one of us (C. A. R., witnessed by R. Whitaker) found an individual of *G. elongata* about 300 km further west than previously recorded. This specimen was found at dusk in Sal forest while returning from gavial survey work on the Ramganga River in northwestern Uttar Pradesh, Garhwal district, about 75 km west of the Nepal border. The specimen was active when found in the vicinity of the Gairal Forest Rest House, Corbett National Park, about 25-30 km northwest of Ramnagar. The specimen was photographed and released because it was found in a national park and collection permits were not available. Color slides are deposited in the Department of Herpetology, Museum of Comparative Zoology, Harvard University (MCZ slide collection catalogue number 778-79) and are available for verification of our identification.

Smith (1931) had speculated that the current distribution of *G. elongata* and *G. travancorica* is relictual and noted a similar distribution in *Malanochelys trijuga*. Smith also contended that it was unlikely that *G. elongata* ever extended across the Gangetic Plain. The Uttar Pradesh specimen and the report of Biswas *et al.* (1978) falsify this contention and suggests that *G. elongata* may yet be found in isolated patches of Sal forest throughout northern India.

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21. SOME FIELD NOTES ON THE NEWLY-DESCRIBED TOAD, *BUFO CAMORTENSIS* MANSUKHANI & SARKAR

In *Bulletin Zoological Survey of India* 3 (1 & 2): 97-101 1980, (Mrs.) M. R. Mansukhani and A. K. Sarkar of the Zoological Survey of India, Calcutta, have described a new species of toad *Bufo camortensis* based partly on specimens obtained by me at Camorta, Central Nicobars on 30th March 1976.

When first seen after dusk they were very common along paths through grass-covered clearings. They were strikingly paler than the Common Toad (*B. melanostictus*) and drew further attention by attempting to climb on to the tussocks of grass in their efforts to escape. When caught, they felt very cold to the touch, another character which appeared to separate them from *melanostictus*. Similar specimens were obtained on Katchal Island, Central Nicobars on 24th March 1977 when there with Dr. K. K. Tiwari, Director, *Z*.S.I., and again noted as cold to the touch.

Toads obtained on the Andaman Islands and on Car Nicobar have been identified as *B. melanostictus*.

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22. EXTENSION OF RANGE OF THE PUTITOR MAHSEER, *TOR PUTITORA* (HAM.) (CYPRINIFORMES; CYPRINIDAE; BARBINAE) TO POONCH VALLEY (JAMMU AND KASHMIR)

In southern Asia the barbs are represented by the closely related genus *Tor* Gray in which the scales are much larger than in the genus *Barbus* Cuvier. These large-scaled barbs, locally known as the Mahseers, are distributed all along the Himalayas, being found in various hill-streams and upper reaches of rivers of the northern latitudes. They are typical rheophiles as their body is adapted to life in mountain torrents and fast-flowing streams. Like the Salmon they are capable of leaping against currents and ascending waters.

In the ichthyofauna of Jammu and Kashmir State the Mahseer is represented by *Tor putitora* (Ham.) which was reported from Kashmir Valley by Hora (1939), Silas (1960) and Das (1965). The present report of the occurrence of this teleost from Poonch Valley is, therefore, an extension of the range of distribution of this species. In Poonch Valley *Tor putitora* (Ham.) is abundantly found in Sooran torrent, Betarh nallah, Poonch River, Mandi stream and Baffliaz, all of which are torrential streams with gravelly bottoms and partially submerged boulders.

Khan (1934) observed that the allied species *Tor tor* (Ham.) occurs in all the hill-tracts of the Punjab except the snow-fed streams whose temperature falls below 60°F in summer. As almost all the streams which contain *Tor putitora* (Ham.) in Poonch Valley are snow-fed streams, it is evident that the putitor mahseer has a greater ecological tolerance and is better adapted to subsist in colder temperatures than *Tor tor* (Ham.).

Das (1960) described the mahseers of the Doon Valley and observed that in *Tor putitora* (Ham.) of the Doons the lips are extensible and sometimes produced with the snout into greatly expanded and swollen lobes for suction, feeding or attachment to rocks in fast-flowing mountain streams. The extraordinary thickening of the lips is not so well-marked in the specimens obtained from Poonch Valley.

ACKNOWLEDGEMENT

I am thankful to Dr. A. G. K. Menon, Dy. Director, Zoological Survey of India, Southern Regional Station, Madras, for confirming the identification of the specimens under report.

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23. DOES FORMALIN PERMIT THE LARVAL DEVELOPMENT IN *AEDES AEGYPTI* AND *CULEX PIPIENS FATIGANS*?

INTRODUCTION

When a six month study was made on the ecology of mosquito larvae distributed in various localities of Tiruchirapalli, the presence of *Aedes aegypti* larvae was accidentally noted in the specimen bottles containing formalin in the post graduate laboratory. So far no report has been published on occurrence of the organisms including mosquito larvae in formalin. In this paper results of the survival capacity of *A. aegypti* larvae in various concentrations of formalin are compared with that of *Culex pipiens fatigans*. To find out whether the mosquito larvae of any species undergo normal development in the formalin and to prove the selective preference of *A. aegypti* for container habitats an experiment was designed using different concentrations of formalin.

MATERIAL AND METHODS

C. pipiens fatigans and *A. aegypti* larvae were collected from a ditch and a broken pot respectively. Formalin concentrations ranging from 0.025% to 0.125% were prepared. Fifteen fourth instar larvae were added to the bottles containing 200 ml of formalin solution of these concentrations. The number of larvae that pupated and emerged as adults was noted. Each experiment was repeated for four times.

RESULTS

The formalin concentrations ranging from 0.025% to 0.075% permitted the survival, pupation and adult emergence of *A. aegypti* and *C. pipiens fatigans* larvae. But the number of larvae that survived, pupated and emerged as adults were high in *A. aegypti*. The larvae belonging to both species did not survive in 0.125% formalin concentration. But the time taken by *A. aegypti* larvae to die was longer than that of *C. pipiens fatigans*. (Tables 1 and 2).

TABLE 1

THE EFFICIENCY OF *A. aegypti* AND *C. pipiens fatigans* LARVAE TO PUPATE IN VARIOUS CONCENTRATIONS OF FORMALIN

Concentration	Number of larvae used		Number of larvae pupated	
	A. aegypti	*C. pipiens fatigans*	*A. aegypti*	*C. pipiens fatigans*
0.025% ..	15	15	11.50±1.29	6.25±0.96
0.050% ..	15	15	9.00±0.82	3.00±0.82
0.075% ..	15	15	7.50±1.29	1.50±0.29
0.100% ..	15	15	4.25±0.96	..*
0.125% ..	15	15	..@	..@

* In 0.100% all *C. pipiens fatigans* larvae died within 12 to 15 hours.
@ In 0.125% all *C. pipiens fatigans* larvae died within 2 to 4 hours and all *A. aegypti* larvae died in 2 days
Values are mean±SD.

TABLE 2

THE EFFICIENCY OF *A. aegypti* AND *C. pipiens fatigans* LARVAE TO EMERGE AS ADULT IN VARIOUS CONCENTRATIONS OF FORMALIN

Concentration	Number of larvae used		Number of adults emerged	
	A. aegypti	*C. pipiens fatigans*	*A. aegypti*	*C. pipiens fatigans*
0.025% ..	15	15	9.25±0.96	3.25±0.50
0.050% ..	15	15	5.50±0.58	3.25±0.96
0.075% ..	15	15	5.25±0.96	2.75±0.50
0.100% ..	15	15	3.50±0.70	..
0.125% ..	15	15	..	..

Values are mean±SD.

DISCUSSION

Bates (1949) classified larval habitats into three categories namely, permanent, transient and container. Larvae belonging to various species inhabit different habitats. Some species prefer a wide range of habitats, while others limit their choice to a few habitats. Thus *C. pipiens fatigans* breeds in all sorts of natural habitats. Similarly *Anopheles subpictus* is found breeding in temporary small sunlit pools, drains and ditches, rice fields and rock pools. Many of the principal and potentially dangerous vectors of mosquito borne viruses breed in specific container habitats. So the larvae of *A. aegypti* are found mainly in the container habitats (Goma 1966). *A. africanus* and *Haemogogus* are found in tree holes, while larvae of *A. simpsoni* are observed in axils of banana and pineapple leaves.

Vijayakumar (1977) reported the occurrence of *A. aegypti* larvae in container habitats such as bottles, tree holes, discarded tins and broken pots. He also reported the absence of *C. pipiens fatigans* larvae in container habitats. In this present report it is found out that the low concentrations of formalin permitted the survival of these two species of mosquito larvae. But the data clearly shows that the larvae of *A. aegypti* thrived well in formalin solution than *C. pipiens fatigans* larvae. The reason for the poor survival capability of *C. pipiens fatigans* when compared to *A. aegypti* larvae in formalin solution may be attributed to its habitat preference. The bottles are included under container habitat. On rearing these two species, one characteristic of container habitat and other not, naturally the former did well. Thus the present study establishes that the low concentrations of formalin permit the normal development of mosquito larvae and that the habitat has an influence over the development.

I am grateful to Dr. V. Hari Rao for his interest and encouragement.

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VIJAYAKUMAR, I. (1977): An ecological study of mosquito larvae in and around Tiruchirapalli, M.Sc. Thesis, University of Madras, Madras.

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24. RECORD OF *EPHESTIA CAUTELLA* WALKER (PYRALIDAE: LEPIDOPTERA) FROM CHILLY POWDER AT LUDHIANA, PUNJAB (INDIA)

During July 1976 chilly powder kept for home consumption were found webbed and a number of pinkish white larvae were present in the silken tubes. The glass jar (15 cm × 5 cm) containing the powdered chilly along with the larvae top covered with muslin were kept in an incubator at 30°C. The emerging adults were identified as *Ephestia cautella* Walker.

Earlier records of this species are on dried fruits such as currant, raisins, apples, dates, berries, figs, almonds, carobs, walnuts, pistachu, *Prunus*, oil palm kernels and also on fallen and damaged citrus fruits. It has also been recorded on chocolate, cocoa beans, soyabean, biscuits, tamarind seeds, lac, malted milk, dried mango juice, garlic bulbs, stored onion, apricot seeds, ground nut kernels, sesamum, cotton seed, cereals and cereal products. The larvae of *E. cautella* have also been found feeding on *Ceretovauna lanigera* Zhnt. *E. cautella* appearance in powdered chillies is a new record.

We are thankful to Dr. A. S. Sidhu the then Professor and Head, Department of Entomology for providing the necessary facilities and to the Director, British Museum, Commonwealth Institute of Entomology, London for identification of the specimen.

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25. NEW RECORD OF *SCAMBUS* (*SCAMBUS*) *STRIATUS* GUPTA AND TIKER (ICHNEUMONIDAE: HYMENOPTERA) FROM *PECTINOPHORA GOSSYPIELLA* (SAUNDERS) AND ITS BIOLOGY

Pectinophora gossypiella (Saunders) is a serious pest of cotton and the natural enemies of this pest are being studied in the Punjab to use them as biological control agents as well as in the integrated control programme. While making collection an ectoparasitoid was observed on a paralysed larva of *P. gossypiella* in a flower at Bhogpur, Punjab. The parasitoid was reared in the laboratory and an adult female emerged. It was identified by Dr. I. D. Gauld of the Commonwealth Institute of Entomology, London as *Scambus* (*Scambus*) *striatus* Gupta and Tiker. This species is known only from Kodaikanal, Palni hills, Tamil Nadu (India) and was described by Gupta and Tiker (1967) on the basis of net collected female specimens.

The female was kept in a large size glass chimney. The open sides of the chimney were covered with pieces of voile cloth. Thirty per cent honey solution was given as food in a cotton swab which was hung from the top of the chimney. Progeny of the virgin female were obtained. The larvae of *P. gossypiella* and *Corcyra cephalonica* Stainton were tried as laboratory hosts. The fourth instar larvae at the rate of ten per day were exposed to the female. The larvae were kept on the upper side of the glass chimney in facial tissue paper folds. The tissue paper with host larvae was covered with a glass slab (10 cm × 10 cm) to restrict the host movements. The host larvae paralysed on each date were reared in petridishes (3 cm dia.) and the pupae formed were transferred to battery jar (15 cm long and 10 cm dia.) The *P. gossypiella* larvae were exposed for ten days and that of *C. cephalonica* for two days.

It was observed that only the larvae of *P. gossypiella* were accepted for oviposition. The larvae were paralysed before oviposition. Two to three eggs were deposited daily at the rate of one per host. The egg + larval period was completed in 5.8 ± 0.7 ($n = 11$) days while the corresponding figure for pupal period was 9.6 ± 1.6 ($n = 11$) days at 24.6 ± 2.1°C and 62.0 ± 6.6 per cent relative humidity. The adults lived up to 20.3 ± 6.8 days.

We are thankful to Dr. B. S. Chahal, Professor-cum-Head, Department of Entomology, Punjab Agricultural University, Ludhiana, Punjab for providing facilities and Dr. N. C. Pant, Director, Commonwealth Institute of Entomology, London for arranging the identification of the parasitoid.

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GUPTA, V. K. & TIKER, D. T. (1967): Indian species of *Scambus* Hartig (Hymenoptera : Ichneumonidae). *Orient. Insects*, 1 : 225.

26. A NEW RECORD OF A PARASITIC FLESH FLY, *PARASARCOPHAGA KNABI* (PARKER) (SARCOPHAGIDAE : DIPTERA) ON THE OAK TASAR SILKWORM

Antheraea proylei Jolly, commonly known as Oak Tasar silkworm, is a sericigenous insect which has helped in a big way to the socio-economic uplift of the tribal population of the remote hill forest belts of Manipur State by the production of better quality tasar silk. Since this insect is economically very important, the slightest loss from parasites and predators are a great concern to the rearers. Several kinds of such enemies have been observed.

Parasarcophaga knabi (Parker) attacks the different larval instars of this silkworm. The species has so far been recorded from different parts of the country and has been noticed to be attracted to human feces, dead animals etc. and can be reared on meat in the laboratory. It has not been recorded from this region and its parasitism on *A. proylei* Jolly seems to be new.

P. knabi (Parker) has been reported for the first time as parasitic on the larvae of *A. proylei* Jolly from almost all the tasar silkworm rearing farms of the state. The female oviposits her eggs on the body of the host which are glued to the surface of the larva. The number of eggs laid on a single larva varies from 1 to 68. The maggots, on hatching, bore their way through the skin of the host thus causing injury and even death of the infested larva. Infestation appears since the late first instar onwards, but the maximum incidence has been observed in the 3rd, 4th and 5th instars during the months of April to May and July to September resulting in nearly 10% loss in the production.

We express our deep sense of gratitude to the Director, British Museum, London, for the identification of the parasite.

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27. PREDATION OF THE PLUM SCALE, *EULECANIUM CORYLI* (L.) (HOMOPTERA : COCCIDAE), BY *BALLIA BAYADERAE* MULSANT (COLEOPTERA : COCCINELLIDAE), IN KASHMIR

The plum scale, *Eulecanium coryli* (L.), is a serious pest of plum, quince, apricot, almond and cherry in Kashmir. The brown coloured, mature female scales have a typical, swollen appearance, bearing an outward resemblance to spherical galls. The infested twigs look as if studded with countless, closely packed galls. Under field conditions, these scales are preyed upon by the larvae of the coccinellid, *Ballia bayaderae* Muls., chiefly during late March to early May which checks further multiplication of the pest to a considerable extent.

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28. FOOD AND FEEDING BEHAVIOUR OF THE MOLE CRAB *EMERITA HOLTHUISI* (CRUSTACEA : ANOMURA : HIPPIDEA)

INTRODUCTION

Mole crabs of the genus *Emerita* have evolved combinations of morphological and behavioural modifications which fit them in a hostile intertidal habitat. One of these, is a passive method of filtering food with their antennae.

In the present study some observations on feeding and antennular movements of *Emerita holthuisi* from the west coast of India were made under laboratory conditions. Observations on gut content were also made.

MATERIAL AND METHODS

Extensive mole crab beds are found in Mirya bay, situated 1.5 km west of Ratnagiri. The animals were collected from the beach at Ratnagiri from September 1973 to August 1974 and fixed in 10% formalin for observing gut contents. The stomachs were removed from fresh as well as previously collected animals and preserved in formalin. The contents were first examined with a low-power binocular microscope and the larger fragments were noted, the remainder being usually subsampled by pipetting a drop of the material on a slide and examining under higher magnification. The method followed by Hynes (1950) was used to determine the composition of different food items Charcoal particles were used instead of food particles to determine the feeding behaviour of the animal.

RESULTS

The percentage of full stomach was more in rainy season than in other months (Table 1). The following components were observed in the gut.

Debris :

This category includes all unidentifiable finely divided material. The name is used in place of the more usual term 'debritus', since it was not known whether the material was organic or inorganic.

TABLE 1

FOOD OF *Emerita holthuisi* AS PERCENTAGE OF GUT CONTENT FOR THE PERIOD SEPTEMBER 1973 TO AUGUST 1974

Month	No. of stomachs examined	Diatoms	Spicules	Sand	Foraminifera and Dinoflagellates	Invertebrate egg	Debris
	%	%	%	%	%	%	%
1973							
September ..	19	25	16	2	5	3	49
October ..	20	23	14	3	7	5	48
November ..	20	16	15	3	6	7	53
December ..	20	16	14	4	6	5	55
1974							
January ..	20	20	12	4	5	4	55
February ..	20	28	9	2	7	5	49
March ..	20	21	12	2	5	3	57
April ..	20	30	8	1	6	3	50
May ..	20	30	10	2	4	3	49
June ..	20	39	13	2	6	2	38
July ..	18	35	14	1	6	1	43
August ..	20	30	16	2	5	2	45

Diatom :

Phytoplankton dominated from June onwards upto September and then gave way to Zooplankton. Diatoms form a considerable part of the stomach content. From December upto July they form the main constituent of the gut contents. Diatoms belonging to the following genera were seen at different periods of the year. During January-February *Concinodiscus excentricus* and *Rhizosolenia semispina* were seen in abundance. From March onwards *Chaetoceras*, *Ditylium*, *Thalaniothrix*, *Stepanophyxix*, *Biddulphia* and *Fragilaria* were present in large numbers.

Small invertebrate eggs as well as traces of sand particles were seen in the stomach during September 1973 upto February 1974. Foraminifera and Dinoflagellates form an important constituent of the gut contents during the year.

It was noticed that in the antennular movement the food particles were entangled in all parts of the antenna, but the greatest concentration was at the ends of the shorter inner row of setae and particularly towards the distal end. Every few seconds one antenna was quickly bent into the cavity between the meropodites of the third maxillipeds and the mouth parts and was then withdrawn slowly as the mouth parts removed the food and sand grains. When clean it was extended again and filtering continued for a few seconds before the other antenna was cleaned in the same way. Rarely the same antenna was cleaned twice in succession, while the other one remained in the filtering position. Such repeated cleaning of the same antenna was most frequently seen when an animal was very close to the wall of the glass trough or to another feeding animal ; under these conditions the antenna nearest to the obstacle may either remain withdrawn or be filtering but is rarely cleaned.

The large door-like meropodites of the third maxillipeds are held close to the mouth parts when the animals were not feeding and, with their overlapping setal fringes form a barrier against the encroachment of sand that surrounds the mouth. During feeding their meropodites open outwards to form parallel sides to the mouth region. Even in this position, their setae partially close off the distal end against the sand. Thus the mouth parts can scrape the food off the antenna without taking in too much sand. It was noticed that as soon as an antenna was brought down for cleaning, movements of the propodite and dactylopodite of the maxilliped became quicker from side to side remaining almost parallel to one another all the time. This activity continued whilst the antenna was in the mouth region but as soon as it began filtering again the propodite and dactylopodite activity gradually decreased, to recommence when the other antenna was cleaned.

DISCUSSION

E. holthuisi lives in one of the most rigorous habitats in the littoral zone. Zobell and Felthan (1938) showed that *Emerita analoga* could feed on bacteria but it seems probable that these animals were feeding on bacteria that had clumped and only to a very small extent on the individual cells. They showed that the larger bacteria (*Bacillus merinus* 1.3-8.1μ, *Flavobacterium boreale* 0.6-2.1μ) were used more efficiently than smaller ones.

In the present investigation it was found that feeding is not fully dependent upon the temperature and salinity but on the availability of food. Accordingly the gut contents showed variability in the percentage of their constituents. During the monsoon period the phytoplankton was seen in larger quantity while in other period it was less. The percentage of diatoms during the period November and December was less but increased from January onwards. After the monsoon the zooplankton became the dominant constituent of the planktonic fauna.

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29. ON THE OCCURRENCE OF A FAIRY SHRIMP *STREPTOCEPHALUS SIMPLEX ECHINUS* IN THE FRESHWATER PONDS OF CHINGLEPUT DISTRICT, TAMIL NADU

(*With a text-figure*)

Systematic studies on Branchiopods, especially the phyllopods of India are fragmentary. The first record of phyllopods in India was *Streptocephalus dichotomus* by Baird in 1860. Another species, *S. simplex echinus*, was reported from Godavari town in Andhra Pradesh by Bond (1934). They occur along with *S. dichotomus*. *S. dichotomus* is the only species of this genus reported in Tamil Nadu, although Sanjeeva Raj (1951) reported the occurrence of yet another anostracan *Branchinella kugenumaensis*. During a survey of *S. dichotomus* in the temporary ponds of Chingleput district near Vedanthangal, Tamil Nadu, the occurrence of *S. simplex echinus* was noticed.

Males in the collection measured 18 to 20 mm in length and females 17 to 19 mm. The animals are semi-transparent, light brown in colour and smaller than *S. dichotomus*. Body and cercopods of both sexes of *S. simplex echinus* are relatively slender. The cercopods are bright red in colour in all the living specimens, whereas in preserved animals they become white and opaque.

The first antennae of both sexes are irregularly segmented. The second antennae of the male are well developed whereas in the female they are very small and narrow.

The length of the 2nd antennae in the male is about one half of the entire body length. The function of this antenna is said to be that of holding the female during copulation (Kaestner 1970). The dorsal row of spines on the main branch of the finger is more or less regular and does not run over on to the inner side of the branch (fig. 1). There is also a row of short, conical spines along the outer side of the main

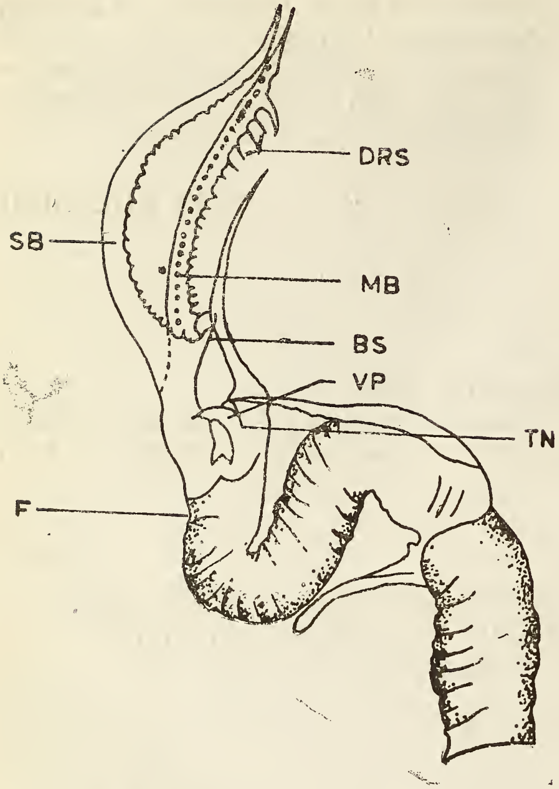

Fig. 1. Second antenna of Male—*Streptocephalus simplex echinus*

Abbreviations: DRS—Dorsal row of spines; MB—Main branch of finger; BS—Basal spine; VP—Ventral process of thumb; TN—Thumb notch; F—Finger; SB—Sickle shaped branch of finger.

branch of the finger. The sickle-shaped branch of the finger is armed with short, closely-set spines. The thumb is long with thumb-notch; its length from thumb-notch is about 4/5 of the length of the main branch of the finger as measured from the dorsal spine. The finger-notch is not well marked.

Specimens of females collected during the month of September were sexually mature. The slender ovisac with about 95-100 eggs extends up to the 5th abdominal segment. Unlike *S. dichotomus* a red pigment is absent in the ventral side of the ovisac. The eggs are brown in colour with hard shells, measuring about 0.2 mm in diameter. An interesting feature is that the distribution of this species is mainly in ponds near Vedanthangal bird sanctuary. This may suggest that the birds visiting these ponds may be instrumental for their distribution (Baker 1926).

A suggestion that the eggs of phyllopods are resistant to the action of the digestive enzymes of birds may be relevant in this instance also (Proctor 1964, Moore & Faust 1972).

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30. INSTAR DURATION, INSTAR NUMBER, EGG PRODUCTION AND LONGEVITY IN *CERIODAPHNIA CORNUTA* SARS AT TWO TEMPERATURE RANGES

INTRODUCTION

Cladocera rich in protein, constitute an important natural fish food entering into the diets of carps, particularly in their earlier stages. The importance of Cladocera as fish food has been emphasised by Forbes (1883) and other investigators. In India, Michael (1962) and Murugan (1975) have studied the life-cycle and biology of several species of cladocerans including *Ceriodaphnia cornuta*, a commonly available species in fresh water ponds. Kanaujia (1979) studied the culture possibilities of *Ceriodaphnia cornuta*. The present study was made to find out the probable effect of temperature on longevity, instar duration, instar number and egg production in *Ceriodaphnia cornuta* under laboratory conditions. The results obtained are presented here.

MATERIAL AND METHODS

Experiments were conducted in two different seasons namely (1) September-October when water temperature ranged between 28°-31°C and (2) November-January when water temperature fluctuated between 16°-25°C. Newly released young ones collected from a 100 ml beaker (where the egg bearing mothers were reared) were inoculated in 15 cavity blocks (50 ml capacity each) filled with pond water filtered through Filter which had 420M filtering capacity. Water in the cavity blocks was changed every 24 hrs. 3-4 drops of fresh cowdung solution were added in each cavity block as additional food for the animalcules.

During the period November-January, to study the effect of food on their life-cycle, one set of specimens was reared only in filtered pond water, while the other set was reared along with 3-4 drops of cowdung solution. The duration of each instar, number of eggs per brood and water temperature were recorded. The data in Tables 1 and 2 present the average values for 15 specimens.

RESULTS

Instar duration, average number of eggs per brood, total number of eggs produced and life span at low temperatures (16°-25°C) were found to be more than at high temperatures (28°-31°C). However, number of instars at low temperature was lower than that at higher temperature (vide Tables 1 and 2).

Each female was found to release eggs inside brood sac just after the 2nd preadult instar and continued to shed eggs after each adult instar. At 28°-31°C the penultimate instar shed no eggs : however, at 16°-25°C last 2-3 instars were with no eggs, although some of the middle instars produced eggs (Table 2).

The relationship between the two variables could be expressed by the formulae ; log no. of eggs—0.2786 log instar number + 0.7223 (for lower temperature range) and log no. of egg 0.2606 log instar number + 0.4863 (for higher temperature range).

The rate of egg production duration of sterile instar and number of sterile instars were higher in cowdung solution than those in filtered pond water. However, cumulative duration of total instars and total life span were found to be lower than that in pond water (Table 1).

DISCUSSION

The present study indicates that the instar duration, number of instars, egg production and longevity of *Ceriodaphnia cornuta* exhibit direct relationship with temperature.

A 27.55 hours instar duration at 28°-31°C, increased to 58.64 hours at 16°-25°C, indicated the influence of water temperature on instar duration. This was found almost similar to the observations of Hall (1962) on *Daphnia galeata mendotae*. Earlier observations by Murugan (1975) at 28°-30°C found to be relevant to present observations. However, it is contradictory with the work of Michael (1962), where the average instar duration has been reported as 32 hours at 28°-31°C. Variations in instar duration may be due to differences in climatic conditions, as the experiments were conducted at three latitudes (West Bengal : 23°N ; Cuttack;

TABLE 1

EGG PRODUCTION, INSTAR DURATION, NUMBER OF INSTAR AND LIFE SPAN AT TWO DIFFERENT RANGE OF WATER TEMPERATURE AND ALSO IN TWO DIFFERENT MEDIA

		Pond water with 3-4 drops cow-dung solution 16-25° C	Filtered pond water only 16-25° C	Pond water with 3-4 drops of cowdung solution 28-31° C
Number of preadult instar	..	2	2	2
Adult instar with eggs	..	17	17	24
Sterile instar	..	3-4	2-3	1
Average instar duration	..	53.75 hrs.	58.64 hrs.	27.55 hrs.
Range of instar duration	..	31-71 hrs.	30-82 hrs.	20-34 hrs.
Duration for sterile period	..	195.60 hrs.	180.00 hrs.	30.00 hrs.
Cumulative duration of total instars (hrs.)	..	1109.40	1162.90	746.00
Average no. of egg per brood	..	10.1	8.18	6.2
Total eggs produced	..	172.5	139.2	150.9
Maximum eggs/brood	..	18	15	13
Total life span (days)	..	46	48	31

TABLE 2

SHOWING INSTAR DURATION AND EGGS BROOD IN 5 ANIMALS (A-E) OF *C. cornuta*

	Instar Number																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
A. Instar duration (hr.) ..	30	42	48	44	30	34	43	36	44	49	51	68	58	48	48	54	58	54	72	80	64	56	20
Eggs per brood ..	—	—	5	8	7	6	9	10	9	12	12	16	0	5	10	5	6	8	4	0	0	0	x
B. Instar duration ..	30	42	48	45	30	37	43	34	48	48	62	62	49	43	43	51	58	52	65	75	72	48	—
Eggs per Brood ..	—	—	2	5	8	8	10	11	10	15	14	8	5	5	14	8	17	11	10	0	0	x	—
C. Instar duration ..	30	42	48	44	30	37	41	36	48	48	60	64	68	48	52	72	48	76	48	—	—	—	—
Eggs per Brood ..	—	—	5	8	9	11	12	11	9	14	14	15	0	0	13	12	12	0	x	—	—	—	—
D. Instar duration ..	30	42	48	48	48	37	37	38	60	64	62	56	62	50	48	48	72	53	79	63	69	56	46
Eggs per Brood ..	—	—	2	6	8	4	9	10	10	10	8	12	10	9	10	10	11	13	0	8	0	0	x
E. Instar duration ..	30	42	48	46	53	39	40	48	48	65	63	63	49	48	56	64	64	56	85	67	48	—	—
Eggs per Brood ..	—	—	5	6	7	7	6	7	10	13	11	10	15	9	10	15	8	2	11	0	x	—	—

0=Sterile instar ; x=Death of the specimen ; —=No eggs.

20°N and Madurai: 9°N) or due to genetic differences (Banta & Wood 1939).

27 instars were recorded at high temperature which was found to decrease to 22 at low temperature, which indicated that the number of broods could be reduced at lower temperature. However, the observations made here are found to be different from those of Michael (1962) and Murugan (1975) who have reported 9 and 20 instars respectively in the same species at same water temperature. An average number of 10.1 eggs per clutch and a total of 172.5 eggs produced during a life span at 16°-25°C was comparatively more than that at 28°-31°C with 6.2 eggs per brood and a total of 150.0 eggs. The average number of eggs per brood at 28°-30°C was found almost similar with the study of Murugan (1975) at higher temperature range and slightly different from Michael (1962). The variations in egg production are due to fluctuation in amount of food, latitude or genetic differences as reported by Dunham (1938), Anderson and Jenkins (1942) and Banta and Wood (1939). Temperature and food availability are the main factors for increasing egg production as also reported by MacArthur and Baillie (1929) in *Daphnia magna*, Hall (1962) in *Daphnia galeata mendotae* and Murugan (1975) in *C. cornuta*. Increase of instar duration at low water temperature could be one of the factors for producing more eggs per brood where the females get more time to produce and accumulate yolk and reproductive cells in the ovary with the required quantity of food.

At 16°-25°C, *Ceriodaphnia cornuta* survived for 46 days whereas at 28°-31°C it survived only for 31 days, which indicated that the animal survived for a longer period at low temperature. Such a phenomena was stated by MacArthur and Baillie (1929) in his study of *Daphnia magna*, where the animal lived for an average of 26, 42 and 108 days at temperatures of 28, 18 and 8°C respectively. It may be noted that the life spans at higher temperature range at different places in the same species are found to be quite different as in Michael's (1962) observation of 12 days and Murugan's (1975) of 21.21 days. Factors responsible for these variations have been discussed earlier.

Ceriodaphnia cornuta passes through 2 preadult instars, 24 adult instars with eggs and a penultimate instar in 31 days of its life span at 28°-31°C. Whereas at 16°-25°C it had similar number of preadult instars, 17 adult instars with eggs and 3-4 sterile instars in 46 days of its life span. These sterile instars were also noticed to occur more than once in the middle of the life-cycle (Table 2). This indicated that *Ceriodaphnia cornuta* may survive for longer period at low temperature, though they may not be fertile for their whole life. The trends of life-cycles are observed here at higher temperature range showing close similarity with the work of Murugan (1975) in *C. cornuta*, and Murugan and Sivaramakrishnan (1976) in *Scapholeberis kingi*, who have also reported penultimate instar with no egg. However, it is different from the observations of Michael (1962) where neither the first and second preadult instars nor the last sterile instars are reported. MacArthur and Baillie (1929) studied *Daphnia magna* and reported for the first time a sterile period during the last few instars.

Cumulative number of eggs produced in two different media is plotted against each instar. The number of eggs per brood and total number of eggs produced were found to be more in specimens reared in cowdung solution and less in filtered pond water, which indicates that *Ceriodaphnia cornuta* can produce more eggs when given suitable food (Table 1). It is well known that the variations in egg production are related to the fluctuation in amount of food as shown by Dunham (1938), Anderson and

Jenkins (1942), and Hall (1962). The present study also indicates that animals reared in a few drops of cowdung solution produced more eggs but lost their fertility and died earlier than those reared only in filtered pond water, showing similar trends of life-cycles as studied by MacArthur and Baillie (1929) who stated that the poor food supply increases longevity and infertility of the animals.

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31. OCCURRENCE OF THE LEECH, *HAEMADIPSA MONTANA* MOORE, IN DARJEELING DISTRICT, WEST BENGAL

The annelids collected during a general field survey by a party of the Zoological Survey of India in the high altitudinal areas of Darjeeling District, West Bengal, contain some specimens of the leech, *Haemadipsa montana* Moore, which according to extant literature is yet unreported from this State. While detailed report of these material will be dealt with elsewhere, opportunity is taken here to record the occurrence of this leech in West Bengal.

Haemadipsa montana Moore, 1927

Material: 6 ex; Palmajua (alt. *c*. 2250 m), Darjeeling Dist., West Bengal; 3 July 1974, P. K. Ghose coll.

Measurement: 15-18 mm long.

The original description of the species by Moore was based on the specimens from Kukkal, Palni Hills, Tamil Nadu. Hingston (cited by Harding and Moore 1927) reported it from Phadma Chen (c 2100 m) and Gangtok (c 1524 m and 2745 m), Sikkim, collected during his Mt. Everest expedition in 1924. Later, Chandra (1970) recorded it from Arunachal Pradesh as well as from Sikkim. Sykes (1955) reported the species from central Nepal between 450 m and 4060 m. The present finding, however, constitutes the first record of this species from Darjeeling District, West Bengal.

Though the bold longitudinal stripes, median dorsal black stripes and pale marginal stripes, characteristic of the species, are present, the marking on the body of the specimens are variable. Variation in the body marking have been reported by earlier workers also.

The senior author is deeply indebted to Dr. Biswamoy Biswas, Emiretus Scientist, not only for his inclusion in this expedition but also for kindly going through this manuscript.

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32. NEW POLYCHAETE RECORDS FROM INDIAN WATERS

(*With twelve text-figures*)

INTRODUCTION

During our study, about 40 polychaete species were collected from the intertidal area of the Vasishta Godavari estuary (16° 18′N, 81° 42′ E) on the east coast of India (Sriniwasa Rao 1978). A perusal of the literature has shown that seven species are new to Indian waters. Two species, *Poecilochaetus johnsoni* and *Magelona cincta* are reported earlier (Srinivasa Rao and Rama Sarma 1978, 1979).

Family: PHYLLODOCIDAE Williams, 1851
Sub-family: PHYLLODOCINAE Williams, 1851
Genus: *Mystides* Theel, 1879

Mystides southerni Banse, 1954

(Figs. 1-2)

Specimens brown in colour and upto 20 mm in length. Prostomium broad, long and somewhat inverted, heart shaped. Antennae short.

Two large eyes near the hind end of the prostomium. First segment with one pair of tentacular cirri ; second with a pair of parapodia and a pair of dorsal cirri and third with parapodia and leaf like ventral cirri. Dorsal and ventral cirri oval in shape. Setae serrated. A pair of oral cirri present.

Family : NEREIDAE Johnston, 1865

Genus : *Dendronereides* Southern, 1921

Dendronereides zululandica Day, 1951

(Figs. 3-5)

Length about 10 mm for about 30 segments. Peristomium slightly grooved between two antennae. Tentacular cirri short and appears as if the dorsal and ventral cirri partially fused segments. Proboscis with soft papillae. Anterior feet with three notopodial lobes and a dorsal cirrus of the same length. Neuropodium with a single broad setigerous lobe ; no inferior lobes ; a very short ventral cirrus. Branchiae from 8th foot formed by four pinnate divisions of the superior lobe of notopodium. Posterior segments in the specimens are broken. Neurosetae are all homogomph spinigers and falcigers with straight blunt blades.

Genus : *Nectoneanthes* Imajima, 1972

Nectoneanthes ijimai (Ijuki, 1912)

(Figs. 6-7)

Body 40 mm long. Prostomium sub triangular with a truncated tip and two short antennae. Palpi are large conical and arise from the antero-lateral sides of the prostomium. Two pairs of eyes. The paragnaths of the proboscis with I=0 ; II=two short rows ; III=0 ; IV= three cones in a group ; V = 0 ; VI = six in an oblique group ; VII and VIII = two continuous rows. Parapodia with cordate dorsal ligule with a pointed end directed laterally. All notopodial and neuropodial setae are homogomph spinigers only.

Family : SPIONIDAE Grube, 1850

Genus : *Prionospio* Malmgren, 1867

Prionospio saldhana Day, 1961

(Figs. 8-10)

Body thread-like, upto 25 mm long for nearly 70 segments. Prostomium rounded and produced back as a keel reaching setiger 2. Four eyes. Setiger one small and fused to the peristome. Four pairs of gills on setiger 2-5. The first three pairs are smooth and the fourth pair larger and pinnate. Anterior notopodial lamellae pointed and face outwards. They reach maximum size on setiger 6 to 9 and then decrease and become rounded. From setiger 20 onwards the lamella are united by dorsal ridges. A maximum of six hooded hooks in the neuropodia from setiger 15 onwards and in the notopodia from setiger 25-35. Each hook with a single tooth above the main fang. An anterior sabre setae in the neuropodium from setiger 12.

Family : AMPHARETIDAE Malmgren, 1867

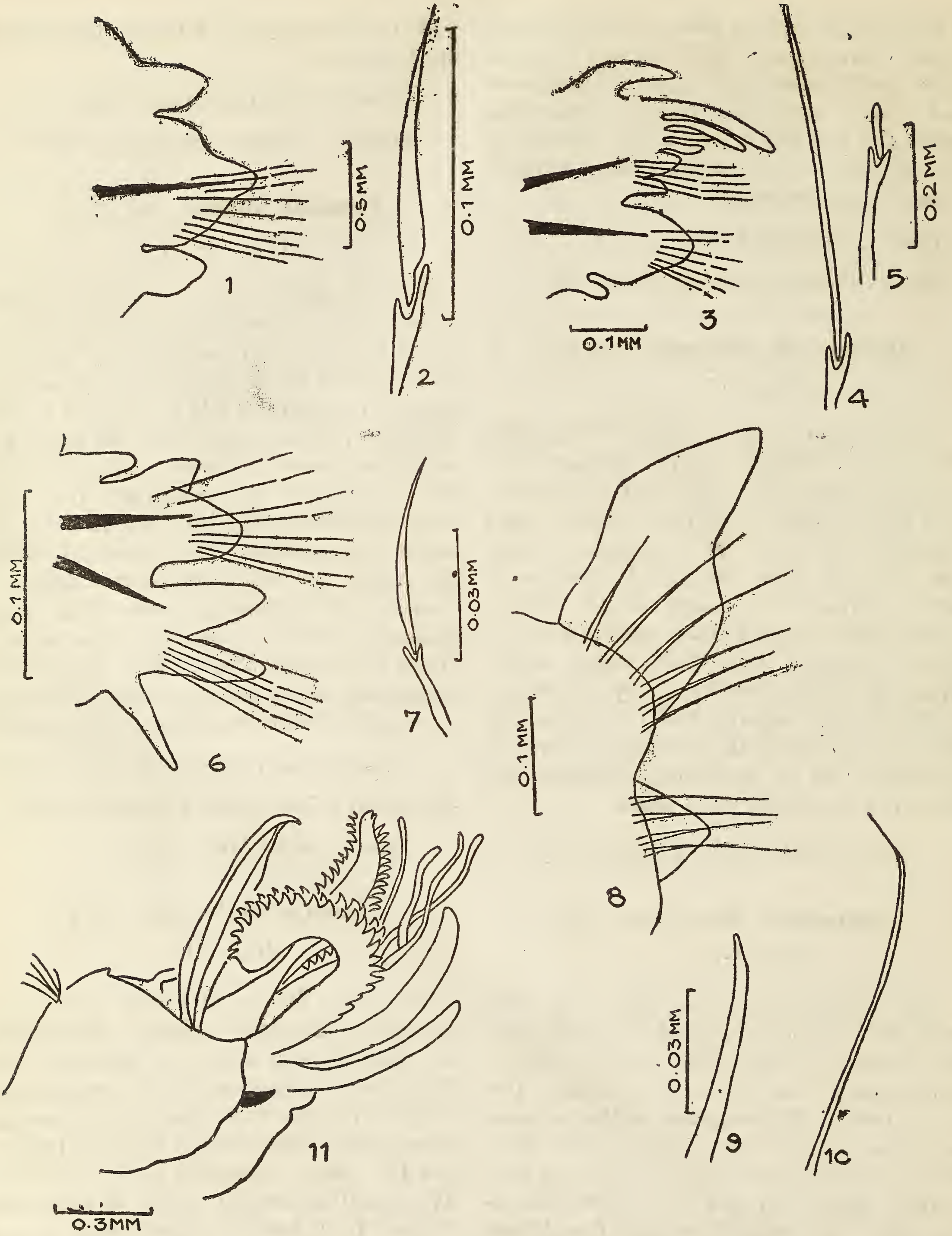
Sub-family : MELINNINAE Chamberlin, 1919

Genus : *Isolda* Muller, 1858

Isolda pulchella Muller, 1858

(Fig. 11)

Body upto 20 mm in length. Prostomium snout-like. Eye spots minute. Buccal tentacles smooth with a groove along one side. Branchiae in two groups of four, inner two pairs of gills with two rows of long, lateral lamellae. Fine acicular neurosetae on segments III-V but not IV. Stout notopodial hooks on segment IV. Small notopodial capillaries on segment V and VI. A total of 13 uncigerous thoracic segments starting from segment VII.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Mystides southerni : Fig. 1. Foot ; Fig. 2. Seta.
Dendronereides zululandica : Fig. 3. Branchiferous foot ; Fig. 4. Heterogomph spiniger ; Fig. 5. Falciger.
Nectoneanthes ijimai : Fig. 6. Posterior foot ; Fig. 7. Spiniger from neuropodium.
Prionospio saldhana : Fig. 8. Anterior foot ; Fig. 9. Sabre seta ; Fig. 10. Hooded hook.
Isolda pulchella : Fig. 11. Anterior view.

Distribution :

Abundance and distribution of these polychaete species in the Vasishta Godavari estuary was studied in detail. Except *Nectoneanthes ijimai* and *Prionospio saldhana* the other three are considered 'rare' to this estuary as they occurred in less than 10 samples out of 270 samples collected during the fifteen month study period (Srinivasa Rao 1978).

Mystides southerni, the small phyllodocid extended upto 16 km in the estuary, in small numbers, generally confining to the mid-tidal mark. *Isolda pulchella* being a filter feeder restricted itself to the confluence area where the substratum is dominated by sand and facilitated its mode of feeding. Very few specimens of *Dendronereides zululandica* were collected in the estuary.

The distribution of *Nectoneanthes ijimai* and *Prionospio saldhana* along the course of the estuary and tidal level is shown in figure 12 based on the number of appearances they made in the 15 samples collected at each tidal level. *P. saldhana* is absent in the first 2 km of the estuary and failed to penetrate beyond 14 km. It always avoided the high tidal levels where temperature changes of high magnitude prevail, and restricted mainly to the low tidal mark and

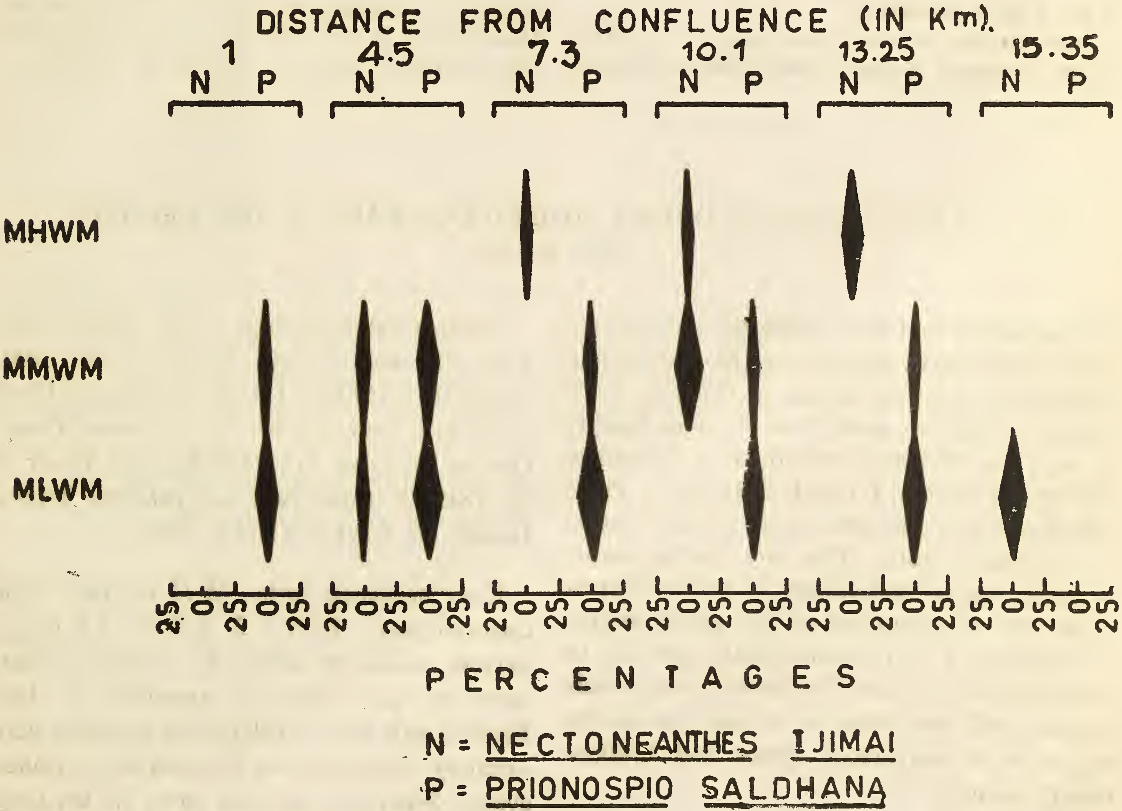

Fig. 12. Abundance and distribution of *N. ijimai* and *P. saldhana* in the Vasishta Godavari estuary.

occasionally appeared at the mid-tidal mark where it is continuously bathed by the incoming tide. On the other hand, *N. ijimai* successfully adapted to the high tidal mark conditions. Perhaps the active burrowing nature of this nereid may help to go deeper during exposure.

ACKNOWLEDGEMENTS

Thanks are due to Andhra University for providing facilities. DSR thanks the C.S.I.R., New Delhi for a fellowship.

DEPARTMENT OF ZOOLOGY,
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WALTAIR 530 003
September 6, 1980.

D. SRINIVASA RAO
D.V. RAMA SARMA

REFERENCES

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SRINIVASA RAO, D. AND RAMA SARMA D. V. (1979): Ecology of *Magelona cincta* Ehlers, 1908 (Polychaeta: Magelonidae) in the Vasishta Godavari estuary, East Coast of India. *Indian J. mar. Sci.*, 8: 182-183.

33. *EXACUM WALKERI* GRISEB. (GENTIANACEAE)—A NEW RECORD FOR INDIA

Exacum walkeri Griseb. hitherto treated as endemic to Sri Lanka was collected from Ponmudi, Trivandrum district, Kerala in the year 1979. Another collection made from the same locality as early as 1933 was unearthed in University College Herbarium, Trivandrum (UCT) *. These collections of *E. walkeri* extend its distribution to Peninsular India. This rare species occurs in moist regions particularly in the crevices of rocks and road-cuttings of the grassy slopes. It resembles *E. zeylanicum* Roxb. but can be distinguished from it by the flowers being mostly solitary and pale blue in colour, as against numerous in corymbose cymes and brilliant blue in colour.

Exacum walkeri Griseb. Gen. et Sp. Gent. 110. 1838 and in DC. Prodr. 9: 45. 1845; Wight Ill. t. 157 b, f. 1. 1850; Clarke in Hook. f. Fl. Brit. India 4: 96. 1883. *E. ovale* Griseb. Gen. et Sp. Gent. 111. 1838 & in DC. Prodr. 9: 46. 1845. *E. zeylanicum* var. *pallidum* Trimen, Handb. Fl. Ceylon 3: 181. 1895.

Erect branched herbs, 25-35 cm tall; stems quadrangular. Leaves 2. 5-4 × 1.5-2 cm, 3-nerved, sessile or subsessile, ovate-lanceolate, acute at apex, acute or rounded at base. Flowers pale blue, axillary and mostly solitary or rarely in terminal few flowered subcorymbose cymes, 5-merous; pedicels up to 1.5 cm long; calyx lobes 9 mm long, winged at base, wings rounded; corolla lobes 1.5 × 6 mm, pale blue, ovate, acute at apex ; stamens up to 6 mm long. capsules ovoid.

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* Abbreviation ours since not included in *Index Herbariorum* (1964).

Specimens examined: CEYLON. C.P.1878 (MH); *s.l.*, Acc. No. 61396 (MH) ; *s. l.* Acc. No. 61397 (MH) ; Adam's peak, 1-3-1883, *s.l.* Acc. No. 61398 (MH). INDIA. KERALA. Trivandrum Dt. : Ponmudi, 25-5-1979, *M. Mohanan* 63278 (MH) Ponmudi, Feb. 1933 *s.l.* 3500 (UCT).

BOTANICAL SURVEY OF INDIA,
COIMBATORE,
November 13, 1980.

M. MOHANAN
A. N. HENRY
N. C. NAIR

34. SOME NEW COMBINATIONS UNDER *PRIMULA* L.

While some botanists including Pax and Knuth (Pflanzenreich IV (237) : 172. 1905) and Handel-Mazzetti (Notes R. Bot. Gard. Edinb. 15 : 259. 1927) treated *Androsace* L. as distinct genus many others treated *Androsace* as a synonym of *Primula* L. Recently Bentvelzen (Fl. Males. 'Ser. 1', 6 (2) : 186. 1962) also treated them as congeneric as it is not possible to demarcate them satisfactorily. This taxonomic treatment necessitates the following new combinations.

Primula croftii (Watt) Derganc var. **scaposa** (Sant. & Banerji) Bennet *comb. nov.*

Androsace croftii var. *scaposa* Sant. & Banerji, Proc. Nat. Inst. Sci. India 24(3) : 137. 1958.

Nepal.

Primula globifera (Duby) Bennet *comb. nov.*

Androsace globifera Duby in DC. Prodr. 8 : 48. 1844 ; Hook.f., Fl. Brit. Ind. 3 : 500. 1882 ; Pax & Knuth in Pflanzenr. IV (237) : 203. 1905. (non *Primula globifera* Griff., Itin. Notes 148. 1837-8, *nom. nud.*)

Western Himalaya.

Primula hemisphaerica (Ludlow) Bennet *comb. nov.*

Androsace hemisphaerica Ludlow in Bull. Brit. Mus. (nat. Hist.) 2 : 76. 1956.

Bhutan.

Primula hookeriana (Klatt) Bennet *comb. nov.*

Androsace hookeriana Klatt in Linnaea 32 : 293, t. 3. 1863 ; Hooker f. *l. c.* 499 ; Pax & Knuth *l.c.* 187.

Eastern Himalaya.

Primula lanuginosa (Wall.) Bennet *comb. nov.*

Androsace lanuginosa Wall. in Roxb. Fl. Ind. 'ed. Carey' 2 : 15. 1824 ; Hooker f. *l.c.* 498 ; Pax & Knuth l.c. 182.

Western Himalaya.

Primula lehmannii (Duby) O.Ktze. var. **longipedicellata** (Knuth) Bennet *comb. nov.*

Androsace lehmannii Duby var. *longipedicellata* Knuth in pflanzenr. IV (237) : 202. 1905.

Nepal.

Primula ludlowiana (Hand.-Maz.) Bennet *comb. nov.*

Androsace ludlowiana Hand.-Maz. in J. Bot. 76 : 283. 1938.

Bhutan.

Primula mucronifolia (Watt) Derganc var. **uniflora** (Knuth) Bennet *comb. nov.*

Androsace mucronifolia Watt var. *uniflora* Knuth in Pflanzenr IV (237) : 188. 1905.

Western Himalaya.

Primula rhizomatosa (Hand.-Maz.) Bennet *comb. nov.*

Androsace rhizomatosa Hand.-Maz. in J. Bot. 76 : 281. 1938.

Bhutan.

Primula rhizomatosa var. **major** (Hand.-Maz.) Bennet *comb. nov.*

Androsace rhizomatosa var. *major* Hand.-Maz. in J. Bot. 76 : 281. 1938.

Bhutan.

Primula sarmentosa (Wall.) Bennet *comb. nov.*

Androsace sarmentosa Wall. in Roxb. Fl. Ind. 2 : 14. 1824 ; Hooker f., *l.c.* 498 *ex parte* ; Pax & Knuth *l.c.* 183 ; Handel-Mazzetti in Notes R. Bot. Gard. Edinb. 15 : 278. 1927.

A. sarmentosa var. *watkinsii* Hooker f. Fl. Brit. Ind. 3 : 498. 1882 ; Pax & Knuth *l.c.* 183 *P.P.* (excl. Chinese Plant).

Himalaya.

Primula sessiliflora (Turrill) Bennet *comb. nov.*

Androsace sessiliflora Turrill in Kew Bull. 1922 : 150. 1922.

Mount Everest.

Primula dubyii (Derganc) Bennet *comb. nov.*

Androsace sarmentosa var. *dubyii* Derganc in Kneucker, Allg. bot. Zeitsch. 10 : 110. 1904.

A. sarmentosa var. *primuloides* (Duby) Hook. f. in Curtis, Bot. Mag. t. 6210, 1876 & in Fl. Brit. Ind. 3 : 498. 1882.

A. primuloides Duby in DC. Prodr. 8 : 51. 1844 (non Moench. 1802 ; nec D. Don 1825) ; Pax & Knuth *l.c.* 183.

A. dubyii (Derganc) Balakrishnan in J. Bombay nat. Hist. Soc. 67 : 62. 1970.

North-west Himalaya.

FOREST RESEARCH INSTITUTE,
DEHRA DUN,
September 30, 1980.

S. S. R. BENNET

35. *MONOTROPA UNIFLORA* LINN.—A NEW RECORD FOR MUSSOORIE HILLS

Recently, two comprehensive books (Gupta 1967, Raizada & Saxena 1978) have appeared on the flora of Mussoorie which also give details of the earlier plant exploration work in the area. A critical and careful comparison of the plants gathered by me from Mussoorie hills with these publications shows that an interesting flowering plant, *Monotropa uniflora* Linn. (family Monotropaceae) has not been recorded hitherto from this very well explored locality. I collected it on two different occasions, in September 1969 and 1977 from Jabarkhet and Jabarkhud respectively. These localities are approximately 5 km from the heart of the town. The species was found to be fairly common in a forest below Jabarkhet Toll.

The forest is dominated by broad-leaved, sclerophyllous, species and is free from biotic interference. Common woody species which have been observed in it are *Cornus macrophylla* Wall., *Dendrobenthamia capitata* Hutch., *Ilex dipyrena* Wall., *Lyonia ovalifolia* Drude, *Quercus incana* Roxb., *Rhododendron arboreum* Sm. and *Viburnum mullaha* D. Don. Shrubby growth is of *Arundinaria falcata* Nees, *Daphne papyracea*

Steud., *Desmodium elegans* DC., *Lonicera quinquelocularis* Hardw. and *Myrsine africana* Linn. Besides, there is a very dense growth of herbaceous plants including ferns. The vegetation is so luxuriant and thick that it makes the forest at certain places almost impenetrable during the rainy season.

There is a distinct layer of humus in the soil overlayed by undecomposed leaf litter. *Monotropa* was fairly common in the decaying vegetable matter on the forest floor. The moisture absorbing humus soil is very slippery and coupled with very thick growth of plants and the absence of any regular path make botanizing hazardous. It appears that probably because of these difficulties, this forest has not been explored botanically at least during monsoon months and hence the plant has escaped the attention of earlier botanists.

A brief description of the plant follows:

A succulent, glabrous, waxy white, nonchlorophyllous, unbranched herb, 10-25 cm tall. Stem erect, covered with alternate, broadly lanceolate, appressed scales 2 ×0.7 cm or under. Normal leaves absent. Flowers 2-3 ×1.5-2.5 cm, waxy white, solitary, terminal, nodding. Sepals 4, scale-like. Petals 5, obovate-oblong. Stamens 10, filaments pilose below. Ovary globose, 5-celled; ovules numerous on axile placentas. Capsule erect, globose, loculicidal, 5-valved.

The plant is often hidden among leaf litter and its location requires patience and concentration. It turns black on drying.

Specimens examined: M. Sharma 545, 5384 (PUN).

Flowers and Fruits: August-October.

I am grateful to Prof. S. S. Bir for guidance and help and to K. M. Vaid for providing herbarium and library facilities at FRI, Dehra Dun.

DEPARTMENT OF BOTANY,
PUNJABI UNIVERSITY,
PATIALA-147 002,
September 26, 1980.

M. SHARMA

REFERENCES

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36. A NOTE ON THE NOMENCLATURE OF TWO PENINSULAR INDIAN PLANTS

Oldenlandia wightii Hook. f. (Rubiaceae) and *Reidia ovalifolia* Wt. (Euphorbiaceae) are two endemic species of southern Peninsular India. The correct nomenclature of these two taxa is given below.

1. **Hedyotis wightii** (Hook.f.) K. K. N. Nair *comb. nov.*

Oldenlandia wightii Hook f. Fl. Brit. Ind. 3: 66. 1880; Gamble, Fl. Presid. Madras 2: 601 (424). 1921.

Type: Western Peninsula, *Robert Wight* Kew Dist. no. 1511; (CAL).

Distribution: South-West India.

Hooker (loc. cit.) erected the species *Oldenlandia wightii* based on Robert Wight's specimens from Peninsular India, characterised by scabrid stems with woody base and triangular-lanceate calyx-lobes which equals the capsules in their length. Gamble (loc.cit.) followed Hooker in considering this plant as a distinct species, but noted 'a stiff herb much resembling the last, perhaps not really distinct'. [Here 'the last' is meant for *Hedyotis umbellata* (Linn.) Lamk.]. Gamble's doubt on the taxonomic status of this plant was verified during the present study and it was found to be quite distinct from *Hedyotis umbellata* in its scabrid stem and branches woody towards base, linear-lanceate, revolute leaves up to 2.5 × 0.3 cm, and hemispherical, scabrid, loculicidal capsules almost covered by the calyx-lobes.

Recent morphological studies of Fosberg (Va. J. Sci. 2 : 106-111. 1941 ; Castania 19 : 25-37. 1954), Shinners (Field & Lab. 17 : 166-169. 1949) and Lewis (South West. Nat. 3 : 204-207. 1959 ; Rhodora 63 : 216-223. 1961) had led to the merging of *Hedyotis* Linn., *Oldenlandia* Linn., *Houstania* Linn., *Kohantia* Cham. and *Excellange* Bremek. under *Hedyotis*. Subsequently, Henry and Subramanyam (Proc. Ind. Acad. Sci. 76 (1) Sect. B. : 28. 1972) and Rao and Hemadri (Ind. Forest. 99 : 372-379. 1973) had transferred most of the Indian species of *Oldenlandia* under *Hedyotis*. *Oldenlandia wightii*, so far treated under the genus *Oldenlandia* is transferred here under *Hedyotis*.

2. **Eriococcus ovalifolia** (Wt.) K.K.N. Nair *comb. nov.*

Reidia ovalifolia Wt. Ic. Pl. Ind. Orient. t. 1904. fig. 3. 1852.

Phyllanthus longiflorus Heyne (Wall. Cat. no. 7905. 1847 *nom. nud.*) *ex* Hook. f. Fl. Brit. Ind. 5 : 302. 1887.

Reidia longiflora (Heyne *ex* Hook.f.) Gamble, Fl. Presid. Madras 2 : 1293 (905). 1925.

Type : Wight Icone 1904. fig. 31 : (Iconotype) (CAL).

Distribution : Southern Peninsular India.

Hooker (loc. cit.) doubted the concept of Mueller (Linnaea 32 : 49. 1865) who considered *Reidia ovalifolia* Wt. and *R. longiflorus* Heyne *ex* Hook. f. as conspecific, on the ground that the leaves in *R. ovalifolia* is comparatively narrow and smaller than that of *R. longiflorus*. A critical study of a number of specimens at Central National Herbarium, Botanical Survey of India (CAL) led the author to the conclusion that the two taxa are one and the same as was accepted by Mueller (loc. cit.) and Gamble (loc. cit.).

The concept of considering *Eriococcus* Hassk. (*Reidia* Wt.) as a distinct genus from *Phyllanthus* Linn. is accepted here. Eventhough Henry and Subramanyam (Taxon 16 : 250-251. 1967) had proposed to conserve the commonly used generic name *Reidia* Wt. (1852) against *Eriococcus* Hassk. (1843) which has priority over *Reidia*, the proposal was not accepted by the nomenclature committee. Hence this new combination is proposed to make the nomenclature of the species up-to-date.

ACKNOWLEDGEMENT

I am thankful to Dr. M. P. Nayar, Deputy Director, Central National Herbarium, Botanical Survey of India, Howrah for all facilities.

BOTANICAL SURVEY OF INDIA,
CALCUTTA-700 016,
September 25, 1980.

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37. NEW DISTRIBUTIONAL RECORDS OF PLANTS FOR NORTH-EAST INDIA

(*With two text-figures*)

During the course of studies on the flora of Meghalaya, we could collect 2 interesting plant species, which were identified as *Cardamine impatiens* Linn., and *Phyllanthus longiflorus* Heyne ex Hk. f., of Brassicaceae and Euphorbiaceae respectively. Reference to literature (Hooker 1872-97, Kanjilal *et al.* 1934-40) revealed that these species are new records for North-East India, and are therefore described here.

Cardamine impatiens Linn. is a highly variable species hitherto recorded from Sikkim to Kashmir mostly in the Temperate Himalayan region (1650 to 4000 m). There are no specimens of this species in the Assam herbarium and the present collection from Meghalaya therefore, forms the first report of this plant from North-East India. This species very closely resembles *Cardamine hirsuta* Linn., but can be easily separated as follows :

Petiole auricled at base; petals less than twice the length of the sepals........ *impatiens*

Petiole not auricled at base; petals twice the length of sepals.............. *hirsuta*

Detailed description and illustrations of this plant are given to facilitate its easy identification.

Cardamine impatiens Linn. Sp. Pl. 655. 1753 ; Hk. f. Fl. Brit. India 1 : 138. 1872 ; Collet, Fl. Simlensis 33. 1902 ; Babu, Herb. Fl. Dehra Dun 56. 1977.

Fls. and *Frts* : February — April.

Distribution : Temperate Himalayas from Sikkim to Kashmir ; temperate Europe and Asia. In Meghalaya noted only in Shillong on moist and shaded localities, rather very rare.

Herbarium specimens examined : Meghalaya: Khasi Hills — Shillong *K. Haridasan* 4600 (NEHU).

Phyllanthus longiflorus Heyne ex Hk. f. has been so far recorded from Deccan peninsular region (Fl. Brit. India 5 : 302), and closely resembles *P. debilis* Herb., particularly in vegetative phase. But the present species can be easily distinguished from *debilis* as follows :

Pedicels much longer than leaves ; sepals in male 4 and in female 6 .... *longiflorus*

Pedicels much shorter than the leaves ; sepals 5-6 in both sexes .... *debilis*

Further, the habitat of these two species are quite distinct; the former occupying (the dry, gravelly, open areas. The specimens from Meghalaya are clearly *P. longiflorus.*

Phyllanthus longiflorus Heyne ex Wall. Cat. No. 7905) Hk. f. Fl. Brit. India 5 : 302. 1887.—*Reidia longiflora* (Heyne) Gamb. Fl. Madras 905. 1925.

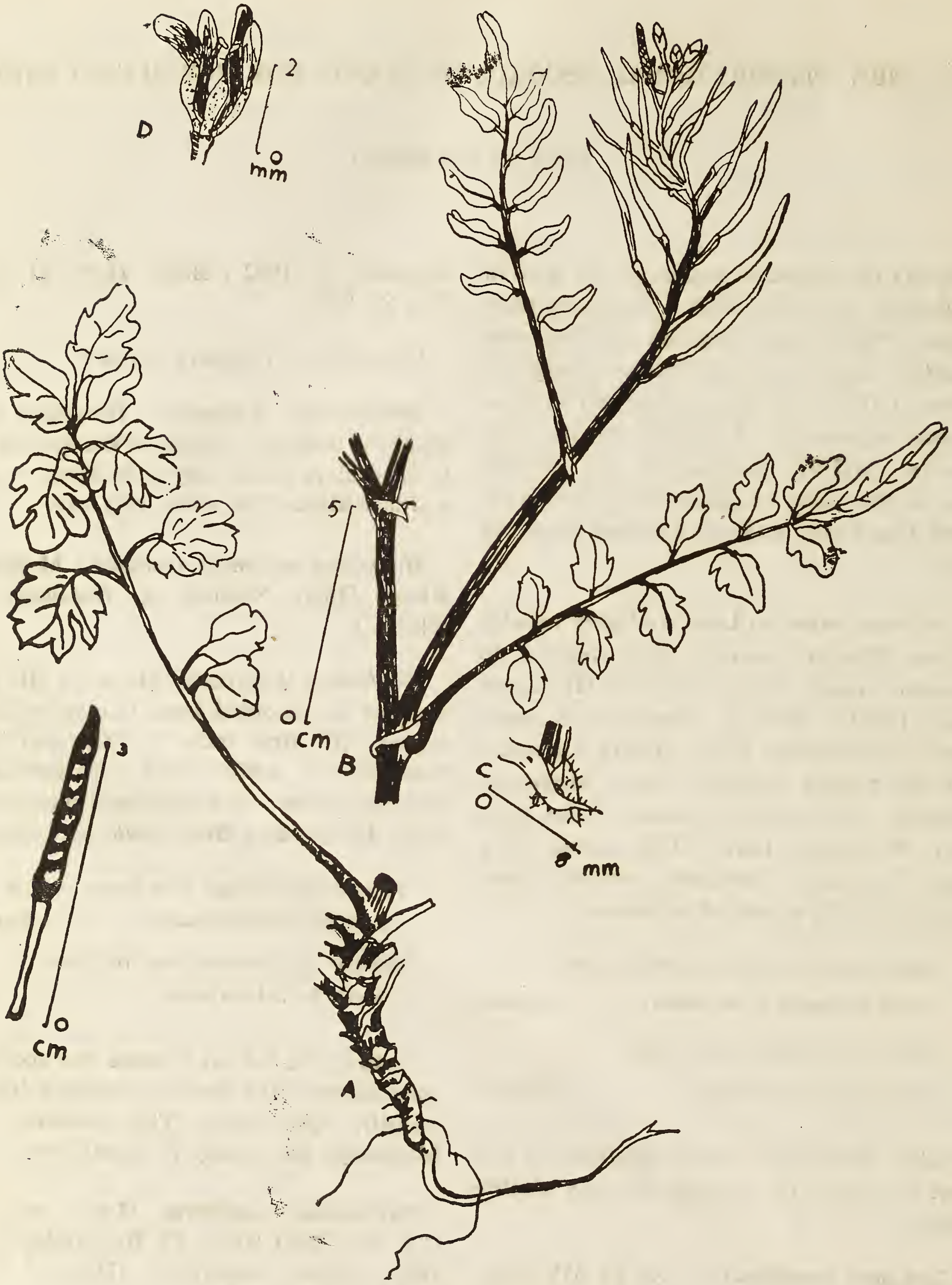
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Fig. 1. *Cardamine impatiens* Linn.

A. & B. Portions of plant, C. Auricled petiole base, D. Flower, E. Fruit.

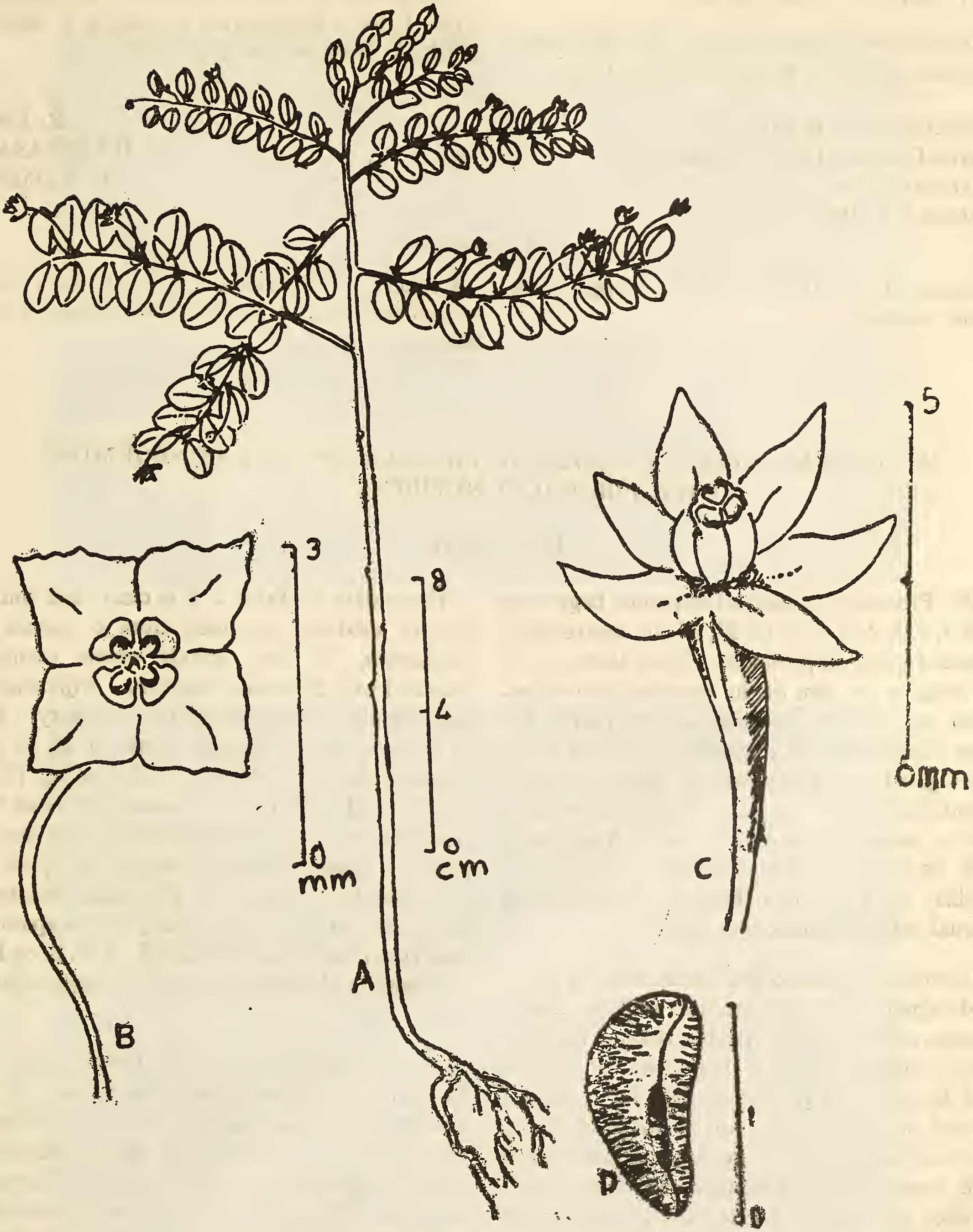
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Fig. 2. *Phyllanthus longiflorus* Heyne ex Hk.f.
A. Habit, B. Male flower, C. Female flower, D. Seed.

Fls. and Frts. : June-December.

Distribution : South India ; in Meghalaya recorded only from Balphakram Sanctuary.

Herbarium specimens examined : Meghalaya : Garo Hills — Balphakram Sanctuary *Y. Kumar* 5402 ; *K. Haridasan* 4156 (NEHU).

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North-Eastern Hill University,
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September 2, 1980.

R. R. RAO
K. HARIDASAN
Y. KUMAR

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Kanjilal, U. N., Kanjilal, P. C., De, R. N., Das, A. and Bor, N. L. (1934-40) : Flora of Assam, 5 vols. Shillong.

38. FLORAL SPIRALS IN *AMORPHOPHALLUS* SPP. NOT CONFORMING WITH FIBONACCI NUMBERS

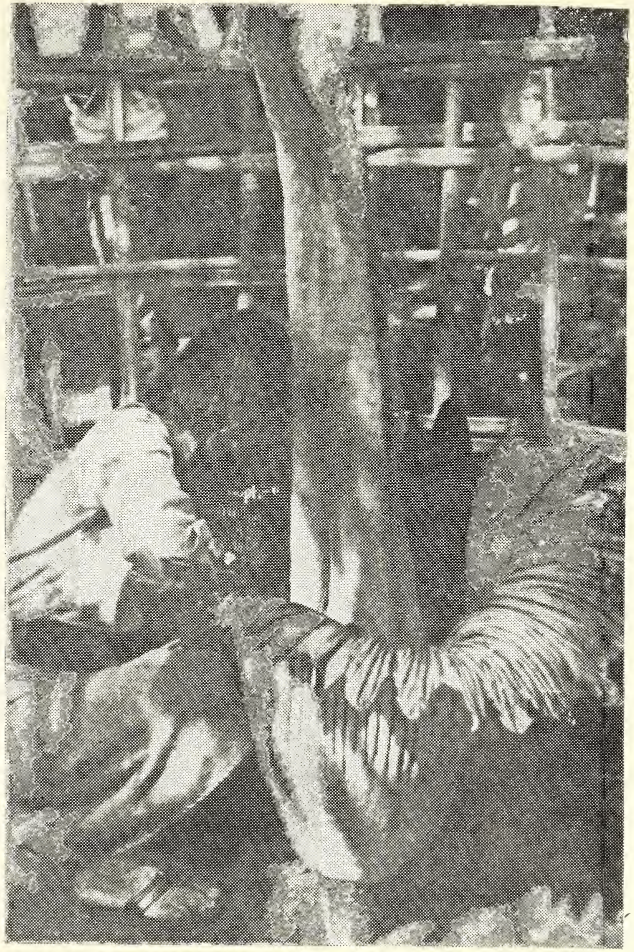
(*With a plate*)

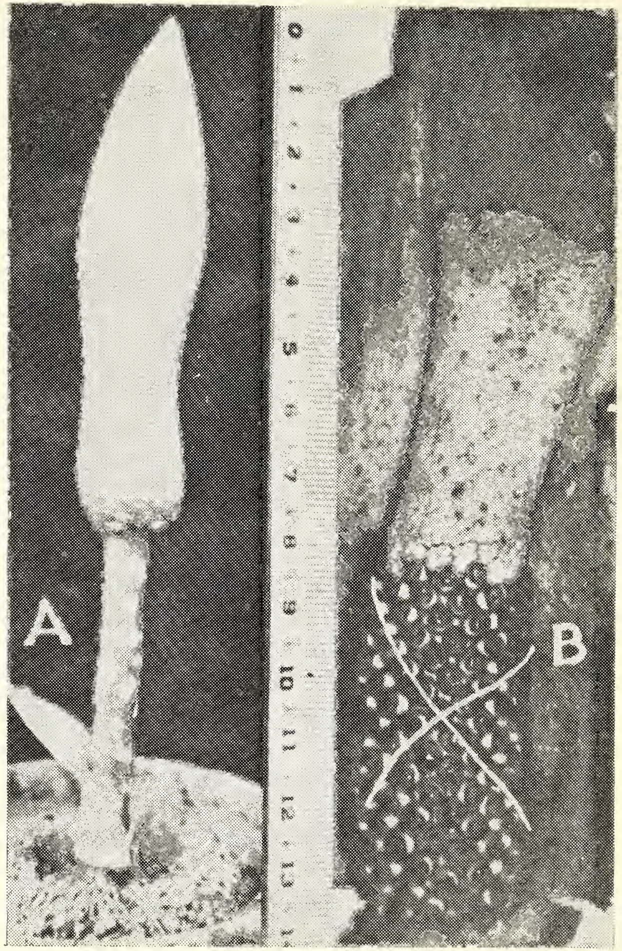
The Fibonacci numerical sequence beginning with 0, 1, 1, 2, 3, 5, 8, 13, 21, 34 etc. has recently assumed great importance. Each term in the sequence is the sum of the previous two terms. There are infinite mathematical properties for these simple-looking sequence which are being investigated by hundreds of Mathematicians round the world who have formed themselves into a society called Fibonacci Association with its headquarters in California, and who publish most of their findings in their own journal called Fibonacci Quarterly.

Fibonacci sequence has application in many fields apart from mathematics, such as, architecture, astronomy, art, poetry, botany, zoology, music, engineering and anthropology. Davis and Bose (1971) published data from several species of aroids. The spiral numbers in the spadix of some of these species matched exactly with some of the Fibonacci numbers, while in other species, the spirals numbers differ from Fibonacci numbers as per summary of data given in Table 1.

From data in Table 1 it is clear, that out of the 73 spadices examined from 6 species of *Anthurium*, 72 bore spirals whose numbers matched with Fibonacci numbers. *Diffenbachia dagneus* also comes under this category. But in the rest of the species, some or all of the spadices do not conform to displaying Fibonacci spirals. It may be mentioned, that the clockwise and counter-clockwise moving spirals within a spadix in any *Anthurium* sp. synchronise with two consecutive Fibonacci numbers. But in five other species, many of the spadices bear equal numbers of spirals (5 : 5, 8 : 8, or 13 : 13) running clockwise as well as counter-clockwise.

The observation reported below relate to four species of *Amorphophallus* grown at the Indonesia Botanic Garden, Bogor, Indonesia. The spadix of none of the species examined displayed spirals in accordance with Fibonacci numbers. The most striking and spectacular of the three species is A. *titanum* whose gigantic inflorescence appears only once in three





Left: Gigantic spadix of *Amorphophallus titanum*.

Right: *Amorphophallus blumei*: A. an unopened spadix; B. closer view of spadix where the spathe has been removed. Note the spiral arrangement of the female flowers.

TABLE 1

SPADICES OF AROIDS DISPLAYING FLORAL SPIRALS THAT MATCH WITH OR DIFFER FROM FIBONACCI NUMBERS

Species	No. spadices showing Fibonacci spirals	Spirals combination	Spadices not matching Fibonacci Nos.
Anthurium macrolobium	20	5 & 8	Nil
A. *clarionervum*	8	8 & 13	Nil
A. *ornatum*	12	8 & 13	Nil
A. *polyrrhizum*	9	8 & 13	Nil
A. *andraeanum rubrum*	10	8 & 13	Nil
A. *crassinervum*	14	13 & 21	1
Schizocasia poteia	18	8 & 13	1
Spathyphyllum sp.	13	5 & 8	3
Diffenbachia dagneus	9	3 & 5	..
D. picta	..	..	17
D. picta viridis	15	8 & 8	3
Aglaonema sp.	1	5 & 8	..
	9	5 & 5	3
Syngonium sp.	5	5 & 5	15
Alocasia indica mettalica	..	..	10
Alocasia sp.	1	5 & 5	17
Philodendron sp.	7	13 & 13	8
Caladium sp.	..	..	13
Total	114+37		91

years. The most recent flowering was in October 1979 when the height of the spadix was recorded as 1.37 metre (Plate). The width of the bloomed flower was 0.825 m. The inflorescence took about one month to bloom from the time of its appearance from the ground (18 September to 18 October 1979). Five days after blooming, the inflorescence started decaying when the spathe could be peeled off and the number of spirals the 469 female flowers displayed recorded. The weight of the tuber was recorded on November 6, 1979 as 22 kg. Its height was 25 cm and maximum diameter 47 cm. The second species examined was A. *blumei* (Plate) which is much smaller compared to A. *titanum*. The third species was A. *campanulatus*, the common edible elephant-foot yam. The fourth species examined was A. *variabilis*, which is very common and cosmopolitan. Data relating to these are shown in Table 2.

TABLE 2

Amorphophallus SPP. NUMBERS OF FLORAL SPIRALS IN EACH

Species	Number of spadices	Number of spirals		Number of female flowers per spadix
		Left	Right	
A. *titanum*	1	18	28	469
A. *blumei*	1	18	13	142
	2	10	14	119
	3	11	8	89
	4	16	11	293
	5	10	13	140
A. *campanulatus*	1	18	11	413
	2	16	24	..
	3	18	17	..
	4	23	25	352
A. *variabilis*	1	7	8	79
	2	8	11	109
	3	10	9	86
	4	8	7	63
	5	8	6	44

Thus, the four species of *Amorphophallus* behave differently from the *Anthurium* species so far as the affinity of their floral spirals with Fibonacci numbers is concerned. The full significance of this problem is not known. Since the situations where Fibonacci system gets involved are regarded as more efficient or more evolved compared to similar situations where Fibonacci system is inoperable, those aroid species whose spadices do not display Fibonacci spirals in the arrangement of flowers have to be regarded as less efficient. Professor R. F. Williams of Division of Plant Industry, CSIRO, Canberra City, Australia who made valuable contributions in this field in 1975 is currently working on geometrical models to explain how departures from the Fibonacci systems occur in situations which are predominately influenced by Fibonacci basis or growth.

I thank Dr. S. Sastrapradja, Director, National Biological Institute, Bogor, for the encouragement and facilities received. Professor T. A Davis, UNDP/FAO Expert, Indonesia drew my attention to an association between the floral spirals in aroids and Fibonacci Numbers and assisted in preparing this paper.

NATIONAL BIOLOGICAL INSTITUTE,
BOGOR, INDONESIA,
September 25, 1980.

ELIZABETH A. WIDJAJA

REFERENCES

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39. ON THE OCCURRENCE OF *SALACIA KHASIANA* IN ARUNACHAL PRADESH

During a botanical exploration in the Tirap Forest Division of Arunachal Pradesh, we collected a specimen of a rare scandent shrub which was conspicuous on account of its orange, warty fruits about the size of a small guava. After a critical study at the Forest Research Institute Herbarium, Dehra Dun, the specimen was identified as *Salacia khasiana* (Hippocrateaceae). It was earlier collected by Shri Ram Sharma from Umteswar Forest in Khasi Hills, Meghalaya and described by C. S. Purkayastha (*Ind. For.* 64 : 277. 1938). The present report of its occurrence in Arunachal Pradesh is therefore, of phytogeographical interest.

Specimen examined :

3rd November 1976, Nakfun range, Tirap Forest Division (Arunachal Pradesh) *K. M. Vaid & H. B. Naithani* ser II No. 175.

Habitat : On the bank of a shaded nullah.

K. M. VAID
H. B. NAITHANI

SYSTEMATIC BOTANY BRANCH,
FOREST RESEARCH INSTITUTE,
DEHRA DUN-248 006.
September 25, 1980.

40. REDISCOVERY OF *METEOROMYRTUS WYNAADENSIS* (BEDD.) GAMBLE (MYRTACEAE) MORE THAN A CENTURY AFTER ITS EARLIER COLLECTION

The genus *Meteoromyrtus* Gamble (Myrtaceae) is endemic to India (Willis 1973) and is known only from Wynad District, Kerala. It is represented by a single species *M. wynaadensis* (Bedd.) Gamble. After the type collection from Devalicottah, S. E. Wynad by Beddome no information about the species was forthcoming.

The status of this taxon was uncertain. Beddome (see below) treated it as *Eugenia wynaadensis* Bedd. Duthie (in Hook. f. Fl. Br. India 2 : 506. 1879) remarked that, ' It seems intermediate between *Pimenta* and *Eugenia* having the pendulous ovules of the former and the habit and inflorescence of the latter '. He also stated that ' This is probably as Col. Beddome suggests the type of new genus intermediate between *Pimenta* and *Eugenia.* The material at my disposal are too incomplete for the preparation of a proper generic description. The above is compiled from Col. Beddome's description of the plant '. Therefore, Duthie (loc. cit.) included the taxon under doubtful and excluded species under *Eugenia.* Gamble (Kew Bull. 1918 : 241. 1918) erected a new genus *Meteoromyrtus* based on the material of Beddome and pointed out that since ' Both Beddome in his Icones and Duthie in the flora of British India have signalized this species as being probably the type of the genus, and so I have no hesitation in describing it as such in spite of the poor material, in order to bring the plant into its proper place in the Madras Flora '.

An intensive search for this little known species was made since 1977 in the Districts of Wynad and the adjoining Cannannore and a population of it was located at a place near Chandanathode in 1979. As the fruit of this species was not seen either by Beddome or Gamble, the plants were kept under observation for more than two years and no fruiting material could be obtained although the plants flower profusely. Biology of the species, therefore, needs closer investigation. Further, since this taxon shares intermediate characters between *Pimenta* and *Eugenia* a biosystematic study may be rewarding from the evolutionary point of view.

Henry *et al.* (1979) included it under rare and threatened flowering plants of South India and indicated that there is no specimen of the taxon in MH. But, on a close study of the unidentified species of *Eugenia*, a sheet of the taxon collected from Wynad with the remark *Eugenia* new sp. could be located. No other data was available on the sheet. In the old accession register of MH it is indicated that the specimen was collected by Beddome in 1868.

Meteoromyrtus wynaadensis (Bedd.) Gamble in Kew Bull. 1918 : 241. 1918 et Fl. Pres. Madras 1 : 343. 1957 (rep. ed.). *Eugenia wynaadensis* Bedd. in Madras J. Sci. Ser. 3 (1) : 47. 1864 et Fl. Sylv. Part 16 : 115. 1872 et Ic. Pl. Ind. Or. t. 161, 1874 ; Duthie in Hook. f. Fl. Brit. India 2 : 506. 1879.

A small tree up to ± 5 m. Flowers white.

Specimens examined. Theerthundamalai, Chandanathode, ± 975 m, 24-2-1979 *V. S. Ramachandran* 61362, 20-12-1979 *V. S. Ramachandran* 65333, 20-3-1980 *V. S. Ramachandran* 66834. Wynad *Beddome* s.n. (Acc. No. 20969). All sheets are in MH.

Beddome (loc. cit.) gives the flowering time as April. But, in the present locality it flowers from December to April.

As the plants are restricted to a very small area in North Kerala they are likely to be lost because of increasing pressure on land for cultivation, etc. Therefore immediate steps for its conservation are necessary.

ACKNOWLEDGEMENT

We are thankful to Dr. R. Sundara Raghavan, Regional Botanist, Royal Botanic Gardens, Kew, for confirming the identity of the species.

BOTANICAL SURVEY OF INDIA,
COIMBATORE-3.
November 27, 1980.

V. S. RAMACHANDRAN
N. C. NAIR
V. J. NAIR

REFERENCES

HENRY, A. N., VIVEKANANTHAN, K. & NAIR, N. C. (1979) : Rare and threatened flowering plants of South India. *J. Bombay Nat. Hist. Soc.* 75 (3) : 688.

WILLIS, J. C. (1973) : A Dictionary of the Flowering Plants and Ferns. (Revised by H. K. Airy Shaw), Cambridge University Press, Cambridge.

41. *SWERTIA KINGII* HOOK. F.—A NEW RECORD FOR NORTH-WEST HIMALAYAS

J. D. Hooker (1883) described *Swertia kingii* from Sikkim, named in honour of its collector George King. Type specimen is in CAL & K. The species is allied to *S. petiolata* D. Don and *S. speciosa* D. Don, but differs from the former by its winged seeds and from both by its robust habit, broadly ovate-elliptic leaves and larger size of flowers.

During the course of the revision of the fam. Gentianaceae, at Botanical Survey of India, Northern Circle, Dehra Dun, I came across a few specimens, deposited in BSD & DD under the names of *Swertia petiolata & speciosa* D. Don. But careful study of the specimens and protologue, illustration and type of *Swertia kingii* Hook.f. at CAL confirmed the identity of the specimens as *S. kingii* Hook.f.

In literature, *Swertia kingii* Hook.f. is recorded only from Sikkim & Nepal. Therefore the present finding of the taxon from North-West Himalayas, records its extended distributional range from Eastern to Western Himalayas and suggests thereby phytogeographic affinity.

A short description of the species is provided here :

Swertia kingii Hook.f. Ic. Pl. t. 1442, 1883 ; Hook.f. Fl. Brit. India. 4 : 734 ; 1885 (in add. et. corr.) ; Fl. Langtong, 162. 1976.

Type : INDIA : Sikkim NaTung, 24 Aug. 1878, *Dungboo s. n.* (Holo., CAL !, K)

Perennial, erect, robust, branched, bitter, about 100 cm tall herb. *Leaves* broadly ovate-elliptic or oblong-elliptic, subacute, petiolate, 5-7 nerved. *Flowers* in dense panicles, bluish or greenish-blue, 1.5-2.6. cm long. *Calyx* 5-partite ; lobes broadly ovate-lanceolate, acuminate with scarious, crenulate margins. *Corolla* rotate, lobes ovate-oblong, tips crenulate ; glands 2, ovoid-oblong with fimbriate margins. *Capsule* sessile, ellipsoid, *Seeds* numerous, brownish, winged.

Icon : l.c. (!).

Fls. & Frts : September to November.

Distribution : INDIA—Himachal Pradesh, Uttar Pradesh, Sikkim, Nepal.

Ecology : Grows in moist places in shade ; stream beds and alpine grass lands ; 2940-4247 m height.

Uses : Used as substitute for true ‘ chirata ’.

Specimens Examined : *Himachal Pradesh* — Kangra ; Kangra valley, Chhota Banghal, 3920 m, 9 Sept. 1955, *Vaid* 24230 (DD). *Uttar Pradesh* — Tehri : Garhwal forest above Gangi, 2940—3267 m, 5 Sept. 1885, *Duthie* 4214 (DD). Chamoli : Ghangaria, 3200 m, 2 Oct. 1962, *Bhattacharyya* 24304 (BSD).

ACKNOWLEDGEMENT

I thank Dr. U. C. Bhattacharyya, Deputy Director, Botanical Survey of India, Northern Circle, Dehra Dun, for guidance and for providing facilities, needed during the study.

SUNITA AGARWAL

WEALTH OF INDIA,
BOTANY SECTION,
PUBLICATIONS & INFORMATION DIRECTORATE (CSIR),
NEW DELHI-110 012,
December 3, 1980.

42. *SELAGINELLA ORNATA* (HOOK. ET GREV.) SPRING—NEW TO INDIA

(*With a text-figure*)

In the course of revisionary studies of the family Selaginellaceae in India, I came across a few peculiar specimens which on scrutiny of literature and comparison of the specimens from Malay Peninsula and Islands housed in CAL were identified as *Selaginella ornata* (Hook. et Grev.) Spring. Later the specimens were also confirmed as *S. ornata* (Hook. et Grev.) Spring at Royal Botanic Gardens, Kew. *Selaginella ornata* (Hook. et Grev.) Spring is described in detail with illustrations as new to India.

Selaginella ornata (Hook. et Grev.) Spring. Bull. Acad. Brux. 10 : 232. 1843 ; Mém. Acad. Sci. Belg. 24(2) : 259. 1850 ; Alston, Philipp. Journ. Sci. 58 : 371. 1935 ; Reed. Mém. oc. Broter. 18 : 169. 1966. *Lycopodium ornatum* Hook. et Grev. in Hook. Bot. Misc. 3 : 108. 1933.

Stems 15-25 cm, suberect, thick, stramieneous, branched from the base, branches compound. Rhizophores long, thick, throughout the stem except apical ⅓rd part. Leaves heteromorphic, contiguous ; lateral leaves spreading, ovate, oblique at base, obtuse at apex, inner half-leaf ovate, dilated, and ciliate at base, rest dentate ; outer half-leaf semi-oblong, dentate ; axillary leaves ovate, cordate, ciliate at base, dentate above, subacute at apex ; median leaves ascending, subfalcate, ovate, cordate at base, acuminate at apex, dentate. Strobili 5.7 × 1-2 mm, single at the apex of branchlets. Sporophylls dimorphic, dentate ; larger sporophylls ovate, falcate ; smaller sporophylls ovate, acute. Megaspores 300-350 μm, papillate Microspores 32-35, μm, deep orange, verrucose (Fig. 1 A-H).

Specimens examined: ARUNACHAL PRADESH — Bomdila to Rahung, 5-6-1957. *Rao* 8081 (Assam, dupl. CAL). MEGHALAYA Cherrapunji to Mawmlah, 27-9-1956, *Panigrahi* 3558 (Assam). MALAY PENINSULA — PERAK — Larut, 4-4500 ft., Sept. 1881, King's *Collector* 2361, 2411. MALAY ARCHIPELAGO — Java .— Banjoemas ± 900 m. 16-4-1911, *Backer* 355 (CAL).

Distribution: INDIA (Arunachal Pradesh); Malesian Islands, Malay Peninsula.

ACKNOWLEDGEMENTS

Grateful thanks are due to Dr. S. K. Jain, Director, Botanical Survey of India, Howrah for encouragement. I am also thankful to (Miss) F. M. Jarett of Royal Botanic Gardens, Kew for confirming the identity of the specimens.

BOTANICAL SURVEY OF INDIA,
ALLAHABAD,
May 22, 1980.

R. D. DIXIT

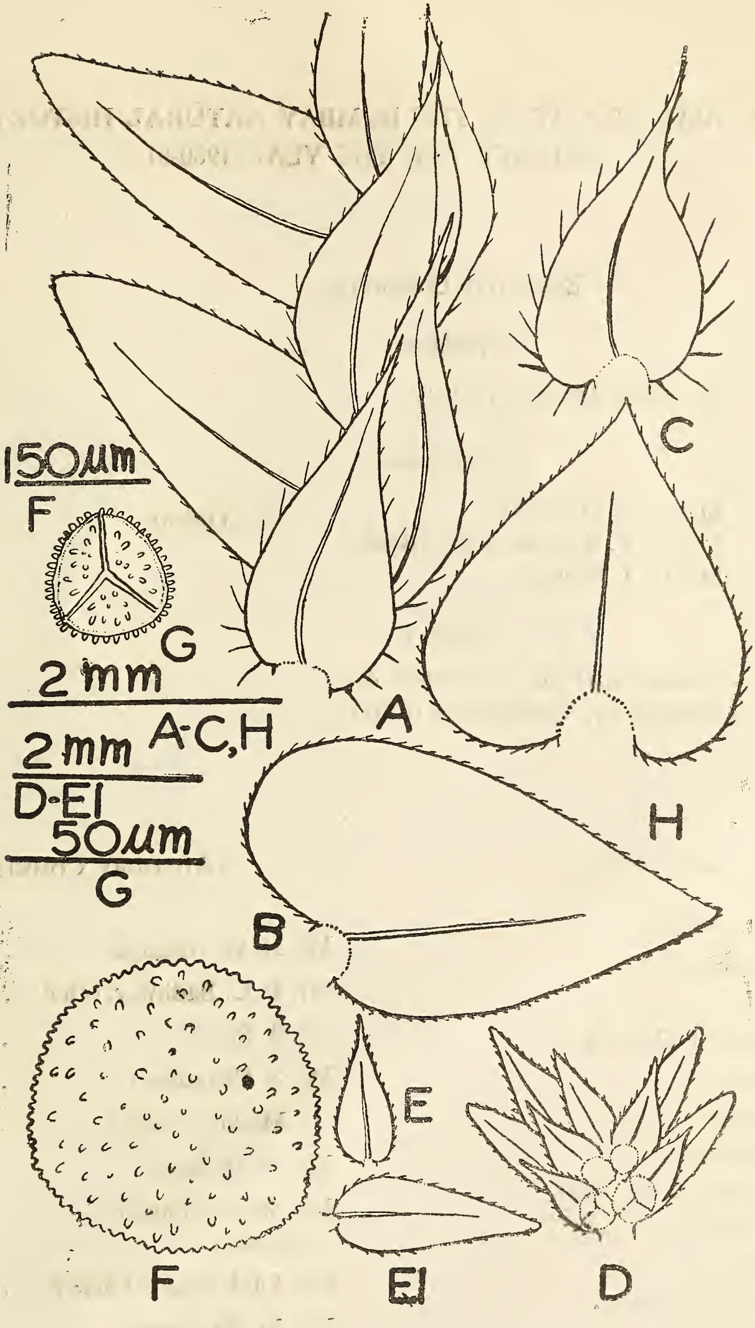
150 µm
F
G
2 mm
A-C,H
2 mm
D-El
50 µm
G
A
B
C
D
E
El
F
H

Fig. 1. *Selaginella ornata* (Hook. et Grev.) Spring

A. Part of a leafy branch; B. Lateral leaf; C. Median leaf; D. Part of strobilus; E. Smaller sporophyll; El. Larger sporophyll; F. Distal part of megaspore; G. Proximal part of microspore; H. Axillary leaf.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1980-81

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HONORARY SECRETARY'S REPORT FOR THE YEAR 1980

97th Annual Report

MEMBERSHIP

There was a steady growth in membership of all categories during the year. However, we can always improve the enrolment rate. This is where members co-operation is essential. We take this opportunity to thank those members who on their own and in response to appeals in the *Hornbill* introduced new members to the Society.

We now appeal to members for assistance in the enrolment of compound corporate members. The Executive Committee has fixed a minimum target of 1,000 compound corporate members so that the corpus will fetch an annual return to meet at least part of the expenditure on administration. Assistance from members who are in a position to influence progressive companies to enrol themselves as compound corporate members would be greatly appreciated. The subscription for compound corporate members is Rs. 1,500 at the present time.

We are glad to report that the number of dropouts has shown a gratifying decline from 217 in 1979 to 97 in 1980. This is an encouraging indication that we are able to hold our members by catering to their interest.

Details of membership for the past quinquennium, showing members fully paid up on 31st December of each year are given in the statement below :

	1977	1978	1979	1980	1981
Ordinary members	512	541	640	660	764
Corporate members	190	180	184	180	168
Life members	246	257	274	305	327
Compound corporate members	1	2	9	9	20
Student members	20	39	96	83	94
Honorary members	4	4	4	4	3
Forest Department Nominees	..	..	..	..	..
	973	1023	1207	1241	1376

Members elected in 1980, but not paid 20
Members paid in 1979, but not paid for 1980 97

PUBLICATIONS

Journal :

Five issues of the Journal were published during the year under review though the effort at catching up with publication dates was not successful and at the end of the year the publication of the issues for August & December 1980 had to be carried over to the next year.

The Journals published in 1980 included all the issues of volume 76 for 1979, the April issue volume 77 (1) for 1980 and a supplement to volume 75 the Journal for 1978. This supplement carried the papers presented as tribute to Dr. Sálim Ali at a symposium on 'Ecology and conservation of birds and mammals in India' held at Bangalore on 11th-13th November 1977. The authors of these papers represent amongst themselves a majority of scientific workers active in this area on the Indian Subcontinent. Other journals published during the year continued to present authoritative information on the natural history of the oriental region.

Hornbill :

The *Hornbill* has now established itself among the members of the Society as a well-liked popular journal presenting matters of natural history in non-technical language for the benefit of most members of the Society. However, a journal of this nature cannot survive unless members provide 'sustenance' in the form of notes and photographs. We appeal to members particularly to those who are active field naturalists to keep the *Hornbill* in mind for notes & photographs.

Books :

During the year we published the 11th edition of the *Book of Indian Birds* by Sálim Ali which includes descriptions and colour illustrations of 16 additional species (making 296 in all) and the 4th edition of the *Book of Indian Animals* by S. H. Prater. Both publications had brisk sales as is evident from the sales statement given below :

	Sales in		Balance stock
	1979	1980	31-12-'80
Some beautiful Indian Trees ..	147	264	2220
Glimpses of Nature in India Booklet	142	353	1804
Checklist of the Birds of Maharashtra ..	148	102	106
Checklist of the Birds of Delhi, Agra & Bharatpur ..	69	54	148
The Book of Indian Birds	..	2197	8009
The Book of Indian Animals ..	..	1007	3905

Books under Publication :

GRASSES OF WESTERN INDIA By T. Hodd (1st edition)

A handy field guide for the identification of Grasses of Western India, with illustrations for all the species described, should be available in 1981.

A SYNOPSIS OF THE BIRDS OF INDIA & PAKISTAN by Dillon Riplay (2nd edition)

This definitive work on bird taxonomy of the Indian region is a standard reference book for any study on Indian birds. The revised 2nd edition now in press is expected to be ready by end 1981.

SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS by Bor & Raizada (2nd edition)

This popular treatise on the wild and cultivated shrubs and climbers occurring in India is an excellent ready reference for members and others interested in the country's flora and the indigenous and exotic cultivars. The second edition, now in the press, is expected to be ready by the end of 1981.

ENCYCLOPEDIA OF INDIAN NATURAL HISTORY, Centenary Publication, 1883-1983 :

It has been decided to entrust the publication of the Encylcopedia to the Oxford University Press, which should ensure a high standard of accuracy, a handsome book, and wide distribution. The Encylopedia is meant for the general reader and paticularly for students in schools and colleges. It should rouse their interest in the natural environment, making them aware and appreciative of rivers, rocks, plants and animals, and all other forms of life around them. Work is proceeding satisfactorily and we hope to bring out the Encyclopedia in time.

A Century of Natural History :

This book will consist of a selection of articles from the Society's Journal published during the hundred years of its existence. The selection will cover general natural history, expeditions and explorations, hunting, fishing, conservation, wildlife photography, mammals, birds, reptiles, fishes, insects, other invertebrates and botany.

CONSERVATION

The Society is recognised by the Central and State Governments in India and by International Organisations abroad as an authoritative source for information on conservation of wild life and natural resources.

This recognition is expressed in the form of association of its officials with State and Central Wildlife advisory boards and representation on the specialist groups of the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources. More positive recognition is the sanction of funds for the study of endangered species of wildlife (see under projects).

Silent valley :

The Society continued to support the campaign for the preservation of the Silent Valley in collaboration with Save Silent Valley Committee and other organisations.

Asian Elephant Specialist Group :

The Species Survival Commission's Asian Elephant Group, which has the Society's Curator as chairman, continued to be active in organising conservation action and protection measures for the elephant in India and in assessing the data obtained from the surveys. The studies are being funded by the World Wildlife Fund.

SEMINARS AND CONFERENCES

The Curator attended meetings of the Species Survival Commission of the IUCN at Sri Lanka, Kenya and U.S.A.

MEMBERS' ACTIVITIES

Field Research :

Assistance was given to two members of the Society Dr. A. J. Gaston and Mr. Vivek Matthai for a survey of Pheasant Status in the Western Himalayas.

Solar Eclipse and wildlife :

M/s. H. K. Divekar and S. R. Amladi with Society's staff investigated the effects of the total solar eclipse on wildlife. Their report is that the effect is negligible.

Bonnet Macaque/Rhesus Macaque Range Boundary :

Dr. Jack Fooden of the Chicago Natural History Museum, a member of the Society assisted by the Society's Staff investigated the range boundaries of the two species of macaques. His report will be published in a future issue of the Society's Journal, for 1981.

Bird counts :

The monthly roadside count of birds at the Borivli National Park on the last Sunday of each month was continued. Apart from the collection of data to record the fluctuations in the bird fauna the main aim is to introduce members to bird watching.

Nature walks :

This programme also assists in recruiting more members for the Society and in fostering interest in natural history among members and others.

Nature walks were organised in Borivli National Park and elsewhere for bird-watching, vegetation studies and general natural history. A large number of members participated.

Nature Camp :

A camp was organised from 15 September-1st October, in Manali, 87 members participated. The camp was organised by Shri Lavkumar Khacher, a member of the Advisory Committee.

RESEARCH & OTHER ACTIVITIES FUNDED FROM FIELD WORK FUNDS

The field work funds available at the Society supported the following activities :

Sálim Ali/Loke Wan Tho Ornithological Research Fund :

During the year the fund supported the field studies of two research students. Mr. S. A. Yahya studied 'The Ecology of Barbets' and Mrs. K. R. Lalitha studied 'Comparative Ecology of Drongos with special reference to Ecological isolation among them'. Mr. Yahya completed his studies during the year. The fund also supported the search for the frogmouth in Kerala a species of bird hitherto considered rare and whose ecology needs to be studied.

Sálim Ali Nature Conservation Fund :

In addition to subsidising the publication of the Hornbill and purchasing books for the library, the following field projects were funded.

(*a*) *Survey of Agastyamalai Hills in Tamil Nadu—a potential biosphere reserve*: A proposal by Dr. Rauf Ali to survey the Agastyamalai as a potential site for a second biosphere reserve in the Sahyadris Biogeographic Province was funded. A report is awaited.

(*b*) *Andaman Survey—Jan.-Mar.* 1980 :

At the instance of Dr. Sálim Ali, the Society organised an ecological survey team consisting of young biologists to spend about two months in the islands to collect data and assess the status of various life forms on certain selected islands. The trip was financed from a grant from the Sálim Ali Nature Conservation Fund. The emphasis of the study was to be (i) gathering of ecological data (ii) Status of endangered species and (iii) collection of biological specimens of scientific interest.

Special attention was to be paid to rare and endangered species like the Andaman Teal, Narcondam Hornbill and Megapode and also to the synecology of the outlying islands such as Narcondam, Landfall, East, Interview, North Reef, South Sentinel, Battye Malve and certain others of the Nicobar group. An assessment of the various development activities in progress and their possible impact on the fauna and flora were to be studied as also, problems connected with the organisation, control and conservation of habitats and wildlife.

(*c*) *Sarus Crane Study* : Mr. Prakash Gole was funded for a study of the breeding behaviour of the Sarus at Bharatpur.

(*d*) *Siberian Crane Study* : Assistance was given to Mr. Yado Mohan Rai, a member from Meerut to investigate possible alternate winter habitats of the Siberian Crane in India. None of the areas visited in U.P. showed any indication of being used by this Crane.

Pirojsha Godrej Fund :

Conservation Education : Assistance was given to Mr. Ulhas Rane to spread the message of Conservation in the Dhule area with the help of a local social organisation, the Jan-Vidyan Kendra.

Solar Eclipse Study : The sudy of effects of total solar eclipse of 16th February, 1980, on wildlife was supported by a grant from the fund.

Col. Burton Fund :

Solar Eclipse study : A second group led by Mr. Ulhas Rane was funded to study the effects of the solar eclipse on 16th February 1980, on wildlife in the Ratnagiri area.

RESEARCH FUNDED BY GOVERNMENT & GOVERNMENTAL AGENCIES

Computer Analysis of Bird Banding Data :

The Tata Institute of Fundamental Research which is collaborating in this programme reported that the entire bird banding data (approximately one lakh thirty thousand records) keyed into the data files have been validated. Retrieval programmes specified by the Bombay Natural History Society has been tried out and the first level reports are ready. The successful run of these programmes suggest the overall validity of the data as far as the data formats and range checks are concerned. It is now possible to extract further reports from these data easily ; but effective utilisation of this facility calls for the availability of the service of a programmer for the Bombay Natural History Society.

We are now seeking a suitable programmer for proper utilisation of the data.

An Ecological Reconnaissance of Vedaranyam Swamp, Thanjavur Dist., Tamil Nadu :

The Vedaranyam—Muthupet—Adhirampattinam swamp—belt is one of the major and important refuges of migratory as well as resident water birds in the peninsula. Every winter (October-March) over 90 species of birds (both Passerine and wading) arrive and spread along the swamps and forested tracts along the seaboard. The State Government has proposed to develop the entire 24,000 hectare swamp as an integrated marine chemical complex, and as an expression of its anxiety about the possible ill effects of such a project on the ecology of the area had asked the Society to undertake a study.

The study had Prof. Neelakantan, a life member of the Society and a well known ornithologist, as field investigator.

The major recommendation made on the basis of a year's data was that in developing the Salt Complex the greatest possible care should be taken to see that in the area set apart for the birds the natural flux (the existing cycles) of the water and fluctuations in salinity, pH value etc. are not altered in any manner.

Studies on the movement and population structure of Indian Avifauna :

This project financed by PL-480 funds received through the Ministry of Agriculure, Govt. of India, plans to investigate the ecology of the bird fauna of selected biotopes, particularly their migratory movements. The main study areas are Keoladeo Ghana, Bharatpur (Rajasthan) and Point Calimere Sanctuary in Tamil Nadu. The study has commenced with Dr. Sálim Ali as Principal Investigator and Mr. S. A. Hussain as Project Scientist.

The programme of work will extend initially over a period of five years.

Hydrobiological (Ecological) Research Station, Keoladeo Ghana Sanctuary, Bharatpur, Rajasthan :

This project plans to study the ecology of the large numbers and variety of water bird species breeding at the Ghana and assembling during winter. The proposed research station would be the first of its kind in India and the research conducted there would provide a basis for research and management of other important waterfowl reserves in the country.

The project has Dr. Sálim Ali as Principal Investigator and Dr. Robert Grubh as Co-investigator.

The programme is originally for five years, but we hope to establish the research station on a long-term basis.

An Ecological Study of Bird Hazards at Indian Aerodromes :

Birds are known to cause slight to severe damage occasionally to aircraft and occupants through accidental encounters. With the advent of faster planes with lesser preceding noise bird strikes have increased, resulting in increased hazards to safe operation of aircraft besides heavy financial losses.

The specific aims of the project were :

1. To identify all bird species that are potentially hazardous to aircaft in and around an aerodrome.
2. To study the habits and basic ecological requirements of these bird species and find out the reasons for their occurrence in and around the aerodrome.
3. To evolve ways to discourage the 'problem birds' from frequenting the airfield and the entire air space used by aircraft in and around aerodromes, on a long-term basis.

The project which is funded by the Aeronautics Research and Development Board of the Ministry of Defence has Dr. Sálim Ali as Principal Investigator and Dr. Robert Grubh as Executive Investigator.

APPROVED PROJECTS

Ecology of Endangered Species and their habitats :

Approval of the Government of India for funding from PL-480 funds for the study has been received. We plan to investigate the Great Indian Bustard and the Asian Elephant.

DONATIONS

	Rs. P.
Col. A. C. Moore *for* Sálim Ali Nature Conservation Fund ..	5,269.00
Pirojsha Godrej Foundation *for* Sálim Ali Nature Conservation Fund	5,000.00
Dr. Sálim Ali *for* Sálim Ali Nature Conservation Fund ..	18,000.00
Darbar Shri Alakhachar Public Trust, Jasdan *for* Sálim Ali Nature Conservation Fund ..	3,000.00
Sir Dorabji Tata Trust *for* Silent Valley Conservation ..	5,000.00
Pirojsha Godrej Foundation *for* Silent Valley Conservation ..	5,000.00
Messrs Glaxo Laboratories *for* Silent Valley Conservation ..	4,000.00
Chetak Trust, Udaipur *for* Silent Valley Conservation ..	5,000.00
Miss Diana Ratnagar, Beauty without Cruelty *for* Silent Valley Conservation ..	2,000.00
Mrs. Perin M. R. B. Jeejeebhoy *for* Silent Valley Conservation ..	1,000.00
Mr. G. V. Bedekar *for* General Fund	1,000.00
Dr. A. N. D. Nanavati *for* Staff Welfare Fund ..	400.00
Mr. M. J. Dastur *for* General Fund	25.00
Mr. M. G. Diwan *for* General Fund	25.00
Amount collected at the exhibition of Rotary Club *for* General Fund	195.00
Amount collected at the Snake exhibition ..	70,000.00

Donations to the Society of more than Rs. 250 qualify for reduction of incometax under section 80 G of the Incometax Act 1961.

REFERENCE COLLECTION

During the year under reference 1073 specimens were registered into the collections.

Mammals	46
Birds	990
Reptiles	36
Amphibians	1
Total	1073

Among these the following species of birds, were additions to the collections :

1. *Spelaeornis formosus*
2. *Myzornis pyrrhoura*
3. *Pteruthius rufiventer*
4. *Yuhina bakeri*
5. *Orthotomus cucullatus*
6. *Abroscopus schisticeps*
7. *Abroscopus hodgsoni*
8. *Certhia nipalensis*
9. *Carduelis thibetana*
10. *Loxia curvirostra*
11. *Propyrrhula subhimachala*
12. *Pyrrhoplectes epauletta*

NATURE EDUCATION SCHEME

The Nature Education Scheme started by the Society as a pioneering effort in 1948 continues to be active among the schools of the city. Considering the large student population in the city and number of schools (over 387), the effect that the Nature Education Organiser, can produce working single handed is limited However, the main thrust of our efforts has been to arrange for the exposure of the urban children to nature in the wild. Apart from introductory slide shows, the children were taken on day field trips to Borivli National Park which is indeed a very convenient wilderness school for Bombay students. In 1980 the snake exhibition organised by the Society proved a very useful aid and 20,000 students of 300 schools were taught the natural history of reptiles.

SNAKE EXHIBITION

The Snake Exhibition organised at Cross Maidan, Bombay by Mr. H. K. Divekar of the Executive Committee and Mr. P. B. Shekar of the Society's staff was extremely popular with the citizens of Bombay. The half hourly lecture by the Society's librarian Mr. I. D. Kehimkar on snakes and their natural history illustrated with live examples enhanced the value of the programme and was very well received. Approximately 2,36,000 people visited the exhibition, yielding a revenue of Rs. 1,80,000.

REPAIRS TO HORNBILL HOUSE

During repairs to the roof in 1979, it was noticed that seepage had severely damaged the concrete roof slabs and these required strengthening involving considerable expenditure. Before arrangements could be made the rains broke and with great difficulty the library was saved from extensive damage by the quick action of the staff.

There was prompt response to our appeal for assistance from the Chief Minister, Maharashtra and the Department of Science & Technology, Govt. of India and the repairs are in progress.

MEETINGS

January, 17 : *Slide show* :
Point Calimere Nature Camp.

January, 26 & 27 : *Nature Camp* :
Kanchad Forests.

February, 10 : *Nature Camp* :
Yewoor Road.

March, 29 & 30 : *Nature Camp* :
Lonavla.

April, 18 : *Talk* :
'A look at the Andamans' by Mr. S. A. Hussain.

April, 27 : *Nature Walk* :
Cheena Creek.

June, 28 & 29 : *Nature Camp* :
Karnala Bird Sanctuary.

July, 13 : *Nature Walk* :
Chinchota Falls.

August, 10 : *Nature Camp* :
Ransai Dam.

August, 17 : *Field Trip* :
Walwan Dam (Lonavla).

September, 28 : *Nature Walk* :
Kanheri Caves.

October, 12 : *Field Trip* :
Elephanta.

November, 6 : *Talk* :
'Birds of East Africa' by Mr. John Karmali.

December, 14 : *Nature Walk* :
Powai Lake.

REVENUE AND ACCOUNTS

The financial situation of the Society has improved. After many years of deficit, the year's working showed a small surplus, after wiping out the accumulated deficit.

STAFF

The Committee wishes to record its appreciation of the willing cooperation of the staff in the activities of the Society, and of the extra efforts willingly made by them to save the Library during early monsoon.

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUSTS ACT, 1950
SCHEDULE VIII VIDE RULE 17 (1)

BALANCE SHEET FOR THE YEAR ENDED 31ST DECEMBER 1980

FUNDS AND LIABILITIES	Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Trust Fund or Corpus:			*Immovable Properties*:		Nil
Life Membership Fund (Individual):			*Investments* (At appropriated value):		
Balance as per last Balance Sheet	1,40,384.03				
Add: Amount received during the year ..	26,950.00	1,67,334.03	50, 8% convertible bonds each of Rs. 100 of Ahmedabad Manufacturing and Calico Printing Co. Ltd. Ahmedabad (fully paid) ..	2,130.20	
Corporate Life Membership Fund:					
Balance as per last Balance Sheet	23,700.00				
Add: Amount received during the year ..	10,500.00	34,200.00	202, 8% redeemable bonds each of Rs. 116 of Ahmedabad Manufacturing and Calico Printing Co. Ltd. Ahmedabad (fully paid) ..	9,982.95	
Fixed Assets Fund:			*Government Securities* (At Cost):		
Balance as per last Balance Sheet	1,00,890.25		3% conversion loan 1946/86 of the face value of Rs. 25,000 ..	25,000.00	
Less: Transferred from Income and Expenditure account on account of depreciation for the year ..	12,061.52	88,828.73	5½% Govt. of India Loan 2000 of the face value of Rs. 2,000 ..	2,000.00	
General Reserve Fund:			In Fixed Deposit with Maharashtra State Road Transport Corporation	80,000.00	
Balance as per last Balance Sheet		37,952.71			1,19,113.15
Building Fund:			*Motor Cars, Motor Cycle & Autocycle*:		
Balance as per last Balance Sheet		4,697.68	Balance as per last Balance Sheet	7,436.03	
Publication Fund:			*Less*: Motor Car MRF 6591 sold during the year ..	3,686.78	
Balance as per last Balance Sheet	94,665.62			3,749.25	
Add: Sale proceeds of Glimpses of Nature Booklets published under WWF/Volkart Foundation grant	1,913.25	96,578.87	*Less*: Depreciation during the year	749.83	2,999.42
Carried over ..		4,29,592.02	Carried over ..		1,22,112.57

BALANCE SHEET FOR THE YEAR ENDED 31ST DECEMBER 1980—(*cont*).

FUNDS AND LIABILITIES	Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought over ..		4,29,592.02	Brought over ..		1,22,112.57
Other Earmarked Funds :			*Furniture Fixture & Equipment* :		
As per Schedule 'A' ..		21,03,157.85	Balance as per last Balance Sheet ..	98,789.19	
			Add : Purchases during the year ..	4,013.50	
				1,02,802.69	
			Less : Sold during the year ..	10,000.00	
				92,802.69	
			Less : Depreciation during the year	11,311.69	81,491.00
Staff Gratuity Fund :			*Loans* (Unsecured considered good) :		
Transferred from Income and Expenditure account for the year ..		80,000.00	To employees ..		1,190.00
Provision for Capital Losses :			*Advances* (Unsecured considered good) :		
Balance as per last Balance Sheet		4,528.38	To employees ..	1,05,293.61	
Provision for Depreciation on Investments :			To others ..	12,792.28	
Balance as per last Balance Sheet		9,266.10	To Nature Education Scheme ..	2,289.08	1,20,374.97
Liabilities :			*Stocks* :		
For expenses ..	84,005.91		(*a*) Publications as per inventory taken & certified by the Honorary Secretary ..	2,38,583.25	
For advance subscriptions ..	7,169.75		(*b*) Cost of Publication under preparation :		
For sundry credit balance ..	22,295.68		1. Synopsis of Birds of India & Pakistan ..	556.50	
For library deposit ..	500.00	1,13,971.34	2. Bundle of Feathers ..	10,304.23	2,49,443.98
Income and Expenditure Account :			*Income Outstanding* :		
Excess of income over expenditure brought over from income and expenditure account ..	75,739.22		Interest accrued ..	39,296.77	
Less : Deficit as per last Balance Sheet ..	75,717.95	21.27	Supplies & services ..	91,335.86	
			Grant Govt. of Maharashtra for 1980-81 ..	1,09,710.00	
			Grant Govt. of India Dept. of Science & Technology for 1980-81	2,20,000.00	4,60,342.63
Carried over ..		27,40,536.96	Carried over ..		10,34,955.15

FUNDS AND LIABILITIES	Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought over ..		27,40,536.96	Brought over ..		10,34,955.15
			Income Tax Refundable :		776.00
			Cash and Bank Balances :		
			(*a*) *In Current account with :*		
			1. Grindlays Bank Ltd., Bombay ..	1,86,300.50	
			2. Grindlays Bank Ltd., London (£1138.20) ..	20,487.60	
			3. Chartered Bank, Bombay	98,027.77	
			In Savings account with :		
			1. Grindlays Bank Ltd., Bombay ..	42,110.66	
			2. Bank of India, Museum Savings Branch, Bombay	41,125.84	
			3. Bank of Baroda, University Branch, Bombay ..	2,97,753.44	
			(*b*) *In Fixed Deposit with :*		
			1. Bank of India (consisting of Rs. 36,000 of Sálim Ali/Loke Wan Tho Ornithological Research Fund and Rs. 3,000 for Col. Burton's Nature Conservation Fund) ..	39,000.00	
			2. Chartered Bank, Bombay (including Rs. 40,000 of Sir Pirojsha Godrej Foundation Fund and Rs. 61,136 of Sálim Ali/Loke Wan Tho Ornithological Research Fund) ..	4,00,000.00	
Carried over ..		27,40,536.96	Carried over ..	11,24,805.81	10,35,731.15

BALANCE SHEET FOR THE YEAR ENDED 31ST DECEMBER 1980—(contd.)

FUNDS AND LIABILITIES	Rs. P.	Rs. P.	ASSETS	Rs. P.	Rs. P.
Brought over ..		27,40,536.96	Brought over ..		10,35,731.15
			Cash and Bank Balances—(contd.)	11,24,805.81	
			3. Grindlays Bank Ltd., Bombay (including Rs. 29,973 of Charles McCann Vertebrate Zoology Field Work Fund)	55,000.00	
			(*c*) *In Monthly Certificate with* :		
			Bank of India, consisting of Rs. 1,25,000 of Sálim Ali/Loke Wan Tho Ornithological Research Fund and Rs. 3,93,751 of Sálim Ali Nature Conservation Fund ..	5,25,000.00	17,04,805.81
Total ..		27,40,536.96			27,40,536.96

Sd./-Sàlim Ali,
President,
Bombay Natural History Society

Sd./-A. N. D. Nanavati
Honorary Secretary,
Bombay Natural History Society

Sd./-C. V. Kulkarni
Honorary Treasurer,
Bombay Natural History Society

As per our report of even date
Sd./-Habib & Co.
Chartered Accountants

Bombay, *6th November*, 1981.

SCHEDULE 'A'

BOMBAY NATURAL HISTORY SOCIETY

SCHEDULE FORMING THE PART OF BALANCE SHEET AS AT 31ST DECEMBER 1980

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total columns* 2, 3 & 4 (5)	*Spent/ returned during the year* (6)	*Refunds/ Adjustments* (7)	*Total of columns* 6 & 7 (8)	*Balance as at 31st December* 1980 (5 *minus* 8) (9)
(1) Field Work Fund (Sir Dorabji Tata Trust) ..	299.14	3,000.00	..	3,299.14	210.00	..	210.00	3,089.14
(2) Staff Welfare Fund ..	3,244.33	8,000.00	..	11,244.33	..	..	..	11,244.33
(3) Sálim Ali/Loke Wan Tho Ornithological Research Fund ..	2,21,136.52	..	..	2,21,136.52	..	..	..	2,21,136.52
(4) Col. Burton's Nature Conservation Fund ..	4,775.34	300.00 (interest)	..	5,075.34	1,254.40	..	1,254.40	3,820.94
(5) Charles McCann Vertebrate Zoology Field Work Fund	29,973.03	600.00 231.00* 2,997.30 (interest)	..	33,801.33	267.98	..	267.98	33,533.35
(6) Scholarship Fund under Sálim Ali/Loke Wan Tho Ornithological Research Fund Investment ..	9,813.53	22,113.65 (interest)	..	31,927.18	20,876.73	..	20,876.73	11,050.45
(7) Grant Govt. of India, Dept. of Science & Technology (Computer Analysing of Bird Banding Data) 1978-79 & 1980-81	12,852.61	84,000.00	..	96,852.61	54,330.30	..	54,330.30	42,522.31
(8) Grant Govt. of India, Dept. of Science & Technology for Encyclopedia of Indian Natural History 1979-80 contd. ..	5,830.65	..	3,291.95 (from BNHS)	9,122.60	9,122.60	..	9,122.60	..
Carried over ..	2,87,925.15	1,21,241.95	3,291.95	4,12,459.05	86,062.01	..	86,062.01	3,26,397.04

BALANCE SHEET FOR THE YEAR ENDED 31ST DECEMBER, 1980—(Contd.)

Name and Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other funds* (4)	*Total of columns 2,3,&4* (5)	*Spent/ returned during the year* (6)	*Refunds/ Adjust-ments* (7)	*Total of columns 6&7* (8)	*Balance as at 31st December 1980 (5 minus 8)* (9)
Brought over ..	2,87,925.15	1,21,241.95	3,291.95	4,12,459.05	86,062.01	..	86,062.01	3,26,397.04
(9) Grant Govt. of India, Dept. of Sc. & Techn. for Publication of some Beautiful Climbers & Shrubs 1977-78, contd. 1978-79, contd. 1979-80, contd. 1980-81 ..	35,716.34	..	..	35,716.34	..	..	..	35,716.34
(10) Grant Govt. of India, Dept. of Sc. & Tech. for Building Repairs 1980-81 ..	..	2,00,000.00	..	2,00,000.00	..	..	..	2,00,000.00
(11) Field Work Fund under Pirojsha Godrej Foundation ..	40,000.00	..	..	40,000.00	..	..	..	40,000.00
(12) Field Work Fund under Pirojsha Godrej Foundation Fund Investment ..	1,875.54	4,000.00 (interest)	..	5,875.54	3,976.00	..	3,976.00	1,899.54
(13) Projector Fund received from members ..	1,414.16	..	..	1,414.16	446.12	..	446.12	968.04
(14) Sálim Ali Nature Conservation Fund ..	3,75,751.66	18,000.00	..	3,93,751.66	..	..	..	3,93,751.66
(15) Conservation Fund under Sálim Ali Nature Conservation Fund Investment ..	29,337.87	38,575.15 (interest)	..	67,913.02	59,682.91	..	59,682.91	8,230.11
(16) IUCN/Elephant Survey Grant	11,743.47	..	5,224.19 (BNHS)	16,967.66	16,967.66	..	16,967.66	..
Carried over ..	7,83,764.19	3,81,817.10	8,516.14	11,74,097.43	1,67,134.70	..	1,67,134.70	10,06,962.73

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfer from other Funds* (4)	*Total of columns 2, 3 & 4* (5)	*Spent/ returned during the year* (6)	*Refunds/ Adjust-ments* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1980 (5 minus 8)* (9)
Brought over ..	7,83,764.19	3,81,817.10	8,516.14	11,74,097.43	1,67,134.70	..	1,67,134.70	10,06,962.73
(17) Indian Institute of Science, Bangalore for publication of Special Issue of Journal ..	26,366.00	..	..	26,366.00	26,366.00	..	26,366.00	..
(18) Sálim Ali Conservation Fund for Salient Valley Campaign expenses ..	1,168.06	22,000.00	2,294.27 (BNHS)	25,462.33	25,462.33	..	25,462.33	..
(19) Col. A. C. Moore Conservation Fund ..	..	5,269.00	..	5,269.00	..	..	..	5,269.00
(20) *Grant Govt. of Maharashtra* :								
(1) Grant for 1979-80 Establishment & Building Maintenance ..	48,727.90	..	..	48,727.90	48,210.38	..	48,210.38	517.52
(2) Grant for 1980-81 Establishment & Building Maintenance ..	..	1,05,710.00	..	1,05,710.00	69,358.92	..	69,358.92	36,351.08
(3) Grant for 1980-81 for Building Repairs ..	..	2,95,000.00	..	2,95,000.00	45,965.04	..	45,965.04	2,49,034.96
(21) Grant Govt. of India, Ministry of Defence, Aeronautical Research & Dev. Board for An Ecological Study of Bird Hazard at Indian Aerodromes ..	..	5,01,342.00	..	5,01,342.00	3,79,119.05	..	3,79,119.05	1,22,222.95
Carried over ..	8,60,026.15	13,11,138.10	10,810.41	21,81,974.66	7,61,616.42	..	7,61,616.42	14,20,358.24

BALANCE SHEET FOR THE YEAR ENDED 31*ST DECEMBER*, 1980—(*Contd.*)

Name of the Fund/Grant (1)	*Balance as per last Balance sheet* (2)	*Additions/ Amounts received during the year* (3)	*Transfers from other Funds* (4)	*Total of columns 2, 3 & 4* (5)	*Spent/ returned during the year* (6)	*Refunds/ Adjust-ments* (7)	*Total of columns 6 & 7* (8)	*Balance as at 31st December 1980 (5 minus 8)* (9)
Brought over ..	8,60,026.15	13,11,138.10	10,810.41	21,81,974.66	7,61,616.42	..	7,61,616.42	14,20,358.24
(22) *Grant from U.S. Dept. of the Interior Fish & Wildlife Service-National Park :*								
(1) Studies on the movement & population structure of Indian avifauna ..	..	7,43,287.28	..	7,43,287.28	6,18,053.10	..	6,18,053.10	1,25,234.18
(2) Hydrobiological (Ecological) Research Station at Keoladeo Ghana Sanctuary, Bharatpur ..	..	6,16,544.00	..	6,16,544.00	71,631.40	..	71,631.40	5,44,912.60
(23) Grant from Tamil Nadu Salt Corporation Ltd., Madras for the study of Ecological Reconnaissance of Vedaranyam Swamp ..	..	47,500.00	..	47,500.00	34,847.17	..	34,847.17	12,652.83
Total	8,60,026.15	27,18,469.38	10,810.41	35,89,305.94	14,86,148.09	..	14,86,148.09	21,03,157.85

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUSTS ACT 1950

SCHEDULE IX [VIDE RULE 17(1)]

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER 1980

EXPENDITURE	Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
To *Expenses in respect of Properties* :			By *Rent* : (Accrued & realised)		..
,, Rates, taxes and cesses/Repairs & maintenance : Met out of Grant Govt. of Maharashtra for 1980-81	45,965.04	45,965.04	,, *Interest* (Accrued & realised) :		
,, *Building Maintenance Expenses* :			On Securities ..	3,134.56	
(As per contra) Met out of the Maharashtra Govt. grant for 1979-80 ..	2,663.95		On Fixed deposits ..	1,16,515.38	
For 1980-81 ..	10,504.97	13,168.92	*Add* : refund of income tax ..	1,961.00	1,21,610.94
,, *Establishment Expenses* :			,, *Donations general in cash* :		1,245.00
Salaries including D.A. etc. (As per contra) from Govt. of Maharashtra grant for 1979-80 ..	45,546.43		,, *Donations towards specific purpose* :		
For 1980-81 ..	58,853.95		Charles McCann Vertebrate Zoology Field Work Fund ..	600.00	
Salaries including D.A. etc. (other than above) ..	1,94,339.58		Sálim Ali Nature Conservation Fund ..	18,000.00	
Society's contribution to Staff Provident Fund ..	10,950.00		Sálim Ali Nature Conservation Fund for Silent Valley Campaign expenses ..	22,000.00	
Ex-gratia payment to retired employees ..	1,093.50		Conservation Fund from Col. A. C. Moore ..	5,269.00	
Postages ..	4,297.15		Sir Dorabji Tata Trust for Field Work Fund ..	3,000.00	
Printing & Stationery ..	12,344.98		Staff Welfare Fund ..	500.00	49,369.00
Advertisement ..	834.00		,, *Grants* :		
Telephone Rental & call charges	3,022.50		(*a*) *Govt. of Maharashtra* :		
Bank Charges ..	993.45		1. For 1980-81 Establishment & Building Maintenance	1,05,710.00	
Meeting expenses including talks, film shows etc. ..	2,500.15		2. For 1980-81 Educational Activity ..	4,000.00	
			3. For 1980-81 Building	2,95,000.00	
Carried over ..	3,34,775.69	59,133.96	Carried over ..	4,04,710.00	1,72,224.94

INCOME AND EXPENDITURE ACCOUNT—(*Contd.*)

EXPENDITURE	Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
Brought over		59,133.96	Brought over		1,72,224.94
To *Establishment Expenses* (Contd.):	3,34,775.69		By *Grants* (Contd.)	4,04,710.00	
Conveyance & travelling expenses (local & up-country)	3,516.64		(*b*) *Govt. of India*:		
Motar cars, Motor Cycles repairs & maintenance	4,083.77	3,42,376.10	1. Dept. of Science & Technology for 1980-81 Journal printing expenses	20,000.00	
To *Audit fees*:		1,000.00	2. For 1980-81 Bird Data Computer Analysing Study	84,000.00	
,, *Amount written off*:			3. For 1980-81 Building Repairs	2,00,000.00	
Bad debts		1,225.04	(*c*) *Govt. of India* (*Ministry of Defence*) *Aeronautical Research & Development Board*:		
,, *Miscellaneous expenses*:			For 1980-81 An Ecological Study of Bird Hazard at Indian Aerodromes	5,01,342.00	
General Charges	2,231.86		(*d*) *Indian National Science Academy*:		
Insurance premium	166.00		For 1980-81 Journal printing expenses	5,000.00	
Repairs to Furniture & Equipment	3,831.06		(*e*) *Tamil Nadu Salt Corpn. Ltd.*:		
Local labour	750.00	6,978.92	For 1980-81 Ecological Reconnaissance of Vedaranyam Swamp	47,500.00	
,, *Depreciation*:			(*f*) *US Dept. of the Interior Fish & Wildlife Service-National Park*:		
On furniture & equipment	11,311.69		1. For studies on the movement & population structure of Indian avifauna	7,43,287.28	
On motor cars, motor cycle & auto cycle	749.83	12,061.52	2. For Hydrobiological (Ecological) Research Station at Keoladeo Ghana Sanctuary, Bharatpur	6,16,544.00	26,22,383.28
,, *Amounts transferred to Reserve or specific funds*:					
Grants transferred to relevant funds	25,93,383.28				
Donations towards specific funds transferred to relevant account in the Balance Sheet	49,369.00				
Sale proceeds of Glimpses of Nature Booklet transferred to Publication Fund	1,913.25				
Sale proceeds of Checklist of Birds of Maharashtra transferred to Charles McCann Vertebrate Zoology Field Work Fund	231.00				
Interest on fixed deposits transferred to respective funds	67,986.10	27,12,882.63			
Carried over		31,35,658.17	Carried over		27,94,608.22

EXPENDITURE		Rs. P.	Rs. P.
Brought over ..			31,35,658.17
,, *Provisions* :			
For Staff Gratuity ..		80,000.00	
For Staff Welfare amenities ..		7,500.00	87,500.00
To *Expenses on objects of the Trust*:			
(*a*) *Educational*: from respective funds (as per contra)			
1. Expenses towards research scholarship & other expenses on Ornithological research out of scholarship fund under Sálim Ali/Loke Wan Tho Ornithological Research Fund Investment ..		20,876.73	
2. Expenses on field staff salaries & other expenses relating to Bird Data Computer Analysing study out of grant Govt. of India, Dept. of Science & Technology 1980-81 ..		54,330.30	
3. Expenses on Encyclopedia of Indian Natural History publication spent: Out of Grant Govt. of India Dept. of Science & Technology 1980-81 ..		9,122.60	
4. Expenses relating to :			
(*a*) Publication of Hornbill Newsletter ..	15,951.50		
(*b*) Research Expedition to Andamans ..	15,288.15		
(*c*) Library book purchase ..	1,000.00		
Carried over ..	32,239.65	84,329.63	32,23,158.17

INCOME	Rs. P.	Rs. P.
Brought over ..		27,94,608.22
By *Income from Subscriptions and Entrance fees* :		
Membership subscriptions ..	48,435.73	
Corporate membership subscriptions ..	18,096.89	
Student membership subscriptions	1,130.00	
Forest Dept. Nominees subscriptions ..	100.00	
Subscription to Journal (non-members) ..	19,121.47	
Entrance fees ..	7,850.00	94,734.09
,, *Income from Publications* :		
Journal Sales ..	958.00	
Glimpses of Nature Booklets ..	1,913.25	
Checklist of Birds of Maharashtra	231.00	3,102.25
,, *Surplus on Sale of Books* :		
Book of Indian Birds ..	42,052.52	
Book of Indian Animals ..	26,577.38	
Some Beautiful Indian Trees ..	4,231.00	
Identification of Poisonous Snake Chart ..	60.00	
Other publications ..	8,896.38	
Nature calendars ..	18,038.76	
	99,856.04	
Add: Surplus on packing charges	5.00	99,861.04
Carried over ..		29,92,305.60

INCOME AND EXPENDITURE ACCOUNT—(*Contd.*)

EXPENDITURE	Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
Brought over ..		32,23,158.17	Brought over ..		29,92,305.60
To *Expenses on objects of the Trust :* (*contd.*) ..32,239.65	84,329.63		,, *Miscellaneous Income :*		
(*d*) Grants to research projects ..19,118.62			Fees for the use of Society's transparencies ..	3,600.00	
(*e*) Other expenses Met out of interest on Sálim Ali Nature Conservation Fund investment .. 8,324.64			Other receipts including Society's share of snake exhibition receipts Rs. 70,000 ..	70,753.85	
	59,682.91				74,353.85
5. Expenses on IUCN/WWF Elephant Survey : Met out of grant from IUCN/WWF ..	16,967.66		By *Administrative Fees :* For handling various funds during the year debited to respective funds ..		1,33,403.74
6. Expenses for field research under interest on Sir Pirojsha Godrej Foundation Fund investment	3,976.00		,, *Profit on Foreign Exchange :* Due to change in exchange rates on our account with Grindlays Bank Ltd., London		219.60
7. Expenses for field research under Charles McCann Vertebrate Zoology Field Work Fund ..	267.98		,, *Profit on Sale of Jeep MRF* 6591	4,313.22	
8. Expenses incurred on film projector ..	446.12		,, *Income on Hire Charges of Jeep to Project :*		
9. Expenses on field studies under Dorabji Tata Field Work Fund ..	210.00		An ecological study of bird hazard at Indian aerodromes ..	24,100.00	
					28,413.22
10. Expenses on Silent Valley Campaign : Met out of Sálim Ali Nature Conservation Fund ..	25,462.33		,, *Transfer to Specific Funds :* Depreciation on fixed assets transferred to Fixed Assets Fund (as per contra) ..	12,061.52	
Carried over ..	1,91,342.63	32,23,158.17	Carried over	12,061.52	32,28,696.01

EXPENDITURE	Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
Brought over ..		32,23,158.17	Brought over ..		32,28,696.01
To *Expenses on objects of the Trust*: (contd.) ..	1,91,342.63		*By Transfer to Specific Funds* (Contd.) ..	12,061.52	
11. An ecological study of bird hazards at Indian aerodromes, met out of grant received from Aeronautical Research & Development Board, Govt. of India, Ministry of Defence ..	3,79,119.05		Expenditure on Establishment & Building Maintenance transferred to Govt. of Maharashtra grant (as per contra) for 1979-80	48,210.38	
			for 1980-81	69,358.92	
			Expenses on Building repairs transferred to Govt. of Maharashtra grant (as per contra) ..	45,965.04	
12. Studies on the movement and population structure of Indian avifauna : Met out of grant from U.S. Dept. of the Interior, Fish & Wildlife Service, National Park ..	6,18,053.10		Expenses on specific objects transferred to relevant funds/grants (as per contra) ..	13,22,613.75	14,98,209.61
13. Hydrobiological (Ecological Research Station at Keoladeo Ghana Sanctuary, Bharatpur : Met out of grant from U.S. Dept. of the Interior Fish & Wildlife Service, National Park) ..	71,631.40				
14. Expenses on Special issue of Journal : Met out of grant from Indian Institute of Science, Bangalore ..	26,366.00				
15. Expenses under Col. Burton's Nature Conservation Fund. ..	1,254.40				
16. Expenses for Ecological Reconnaissance of Vedaranyam Swamp : Met out of grant from Tamil Nadu Salt Corporation Ltd. ..	34,847.17	13,22,613.75			
Carried over ..		45,45,771.92	Carried over ..		47,26,905.62

INCOME AND EXPENDITURE ACCOUNT—(*Contd.*)

EXPENDITURE		Rs. P.	Rs. P.	INCOME	Rs. P.	Rs. P.
Brought over ..			45,45,771.92	Brought over ..		47,26,905.62
(*b*) *Journal expenses*	1,16,590.45					
Less : Met from Indian Inst. of Science, Bangalore as shown above	26,366.00					
		90,224.45				
(*c*) Field study programme & other local field study trips		3,175.80				
(*d*) *Library Account* :						
Subscription to other Societies	2,026.80					
Purchase of Books	6,999.34					
Book binding expenses	2,036.35					
	11,062.49					
Less : Met from Sálim Ali Nature Conservation Fund investment as shown above	1,000.00					
		10,062.49				
(*e*) Maintenance of Reference Collection ..		1,931.74				
			1,05,394.48			
Excess of Income over expenditure carried over to Balance Sheet ..			75,739.22			
Total ..			47,26,905.62	Total ..		47,26,905.62

Sd./-Salim Ali	Sd./-A. N. D. Nanavati	Sd./-C. V. Kulkarni	As per our report of even date
President,	*Honorary Secretary*,	*Honorary Treasurer*,	Sd./-Habib & Co.,
Bombay Natural History Society	Bombay Natural History Society	Bombay Natural History Society	*Chartered Accountants*

Bombay, 6*th November* 1981.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the year ended 31*st December*, 1980

RECEIPTS	Rs. P.	Rs. P.	PAYMENTS	Rs. P.	Rs. P.
To *Balance as at* 1*st January* 1980 :			*By* Refund of advance from Bombay Natural History Society		2,286.15
With Grindlays Bank Ltd., Bombay on Current Account	2,167.00		,, Salary Nature Education Organiser		15,380.20
With Nature Education Organiser	200.00		,, General charges		1,502.25
		2,367.00	,, Postages		113.05
			,, Printing & Stationery		65.30
,, *Grants* :			,, *Balance as at* 31*st December* 1980 :		
Govt. of Maharashtra for the year 1979-80		17,521.00	1. With Grindlays Bank Ltd., Bombay on current account	3,889.40	
,, *Sale of Nature Study Booklets* :		1,259.27	2. Cash on hand with Nature Education Organiser	200.00	4,089.40
Advance from Bombay Natural History Society, Bombay		2,289.08			
Total		23,436.35	Total		23,436.35

Sd./-SALIM ALI	Sd./-A. N. D. NANAVATI	Sd./-C. V. KULKARNI	As per our report of even date
President,	*Honorary Secretary*,	*Honorary Treasurer*,	Sd./-HABIB & Co.,
Bombay Natural History Society	Bombay Natural History Society	Bombay Natural History Society	*Chartered Accountants*

BOMBAY, 6*th November*, 1981.

MINUTES OF THE ANNUAL GENERAL MEETING OF BOMBAY NATURAL HISTORY SOCIETY HELD ON 27TH NOVEMBER 1981 AT 6-00 P.M. AT COOMARASWAMY HALL, PRINCE OF WALES MUSEUM, BOMBAY

The following were present :

1. Mr. G. V. Bedekar
2. Mr. Bansi Mehta
3. Mrs. P. Mukherjee
4. Mr. Humayun Abdulali
5. Mr. M. S. Srinivasan
6. Mrs. Parveen Sisodia
7. Mr. D. J. Panday
8. Dr. A. N. D. Nanavati
9. Dr. C. V. Kulkarni
10. Dr. Sálim Ali
11. Mr. R. E. Hawkins
12. Mr. J. P. Irani
13. Prof. P. V. Bole
14. Mr. S. R. Nayak
15. Mr. M. R. Almeida
16. Mr. Ulhas Rane
17. Mr. Chandrakant Wakankar
18. Mr. Oswald Thail
19. Miss Renee Borges
20. Mr. H. K. Divekar
21. Mrs. D. S. Variava
22. Mr. D. P. Banerjee
23. Mr. V. K. Paralkar
24. Mr. N. D. Mulla
25. Mr. S.D. Bhaumik
26. Mr. R. S. Moral
27. Mr. A. G. Puranik
28. Mr. A. D. Kunte
29. Dr. J. H. Thakkar
30. S/Lt. A. Ranga Rajan
31. Mr. M. B. Sukumar

The President (Dr. Sálim Ali) requested Mr. G. V. Bedekar, Vice President, to take the Chair, and conduct the proceedings.

Agenda item (1)—Committee's Report* for calendar year 1980 (which is the 97th year of the Society's existence) : The Chairman requested the Honarary Secretary (Dr. A. N. D. Nanavati) to present the report of the Committee for the year 1980. As copies of the report had been made available and time had been allowed for perusal, the report was taken as read and the Honorary Secretary invited comments on the report.

Mr. Ulhas Rane pointed out that on page 6 of the report as circulated at the meeting the word 'Ratnagiri' should be corrected to 'Yellapur in North Kanara district', with reference to the 'Solar Eclipse' study. This was accepted.

Mr. Humayun Abdulali, drew attention to the delay experienced by him in receiving old volumes of the Society's journal in connection with the compilation of the book 'A Century of Natural History'. He referred to the absence of the Curator from Bombay, in connection with seminars, conferences and meetings. He also repeated his complaint that the computerisation of the bird banding data has not yet produced specific results. He felt that the association of Dr. Sálim Ali as Principal Investigator of several research projects involved a loss of opportunity to other researchers. The Chairman and the Honorary Secretary explained the correct position regarding the compilation 'A Century of Natural History', the Curator's attendance at important meetings in Bombay and elsewhere and the bird banding data—computerisation project. Mrs. Variava expressed the view that it was due to Dr. Sálim Ali's association with the projects that they were supported by government funds and grants from PL-480 allocations and that the Society was fortunate in this respect. She felt that these projects did not come in the way of other research projects and any member of the Society was welcome to submit for consideration his own research project and if it was found feasible, there would be no difficulty in finding funds for it. Mr. H. K. Divekar stressed that he himself had been allotted funds for his two projects (' Bastar buffalo survey ' and ' solar eclipse study ') and that there was no basis for Mr. Abdulali's complaint, about opportunities and funds for research projects. Mr. Bansi Mehta stated that Mr. Abdulali seemed doubtful about the scientific value of bird counts being conducted but pointed out that bird counts were also meant for creating interest in natural history.

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* see page 467.

Dr. C. V. Kulkarni (Honorary Treasurer) clarified that all research proposals put forward by members were considered carefully and no feasible project would be turned down. It was for members to take the initiative in research.

The Chairman then requested the Honorary Secretary to give a brief account of the activities of the Society during the year 1981 to date. The Honorary Secretary stated that the activities of the Society have increased considerably in extent as well as depth. He added that during 1981 the publication of the Society's journal has been brought to-date, the August 1981 issue having come out on the 28th August 1981. A reprint edition of the Checklist of the Birds of Maharashtra was brought out during the year, and copies are available for sale.

The Honorary Treasurer stated that recently we have received two major donations from Chen Kim Loke Foundation under Sálim Ali Nature Conservation Fund and there is no difficulty whatsoever about funds for research projects.

The Chairman told the members that the project reports of Avifauna, Bird Hazard and Asian Elephant Group, and Vedaranyam Swamp, are available for perusal of members at the Society.

The Committee's report was approved.

Agenda item (2)—The Honorary Treasurer presented the Balance Sheet and Statement of Accounts* for the year 1980 and drew attention to the income and expenditure statement, showing that the Society has been able to wipe out the long standing deficit of Rs.75,717.95 and there was now a small surplus. This was mainly due to the efforts of Mr. H. K. Divekar in organising the snake exhibition at Bombay. Moreover, the Society has been able to create a Staff Welfare Fund for the staff and a sizeable sum has been put into the Gratuity Fund. This was made possible by certain additional activities and by levy of administrative charges on projects run by the Society.

The accounts were approved.

Agenda item (3)—Appointment of auditors and fixing their remuneration: Dr. C. V. Kulkarni (Honorary Treasurer), proposed that Messrs Habib & Co., auditors of the Society for the past several years be appointed for the year 1981 on the same remuneration, *i.e.*, Rs. 1,000. This was seconded by Dr. Nanavati (Honorary Secretary) and carried.

Agenda item (4)—Election of Executive Committee for two years (until the Annual General Meeting for calendar year 1982): The Chairman stated that five nominations for the Executive Committee have been received in addition to the twelve persons recommended by the Committee and an election will be necessary, under the rules. The names recommended by the outgoing Committee are (apart from the Secretary, Govt. of India, Department of Science & Technology):

1. Mr. Humayun Abdulali
2. Dr. S. R. Amladi, M.D.
3. Prof. P. V. Bole
4. Mr. Divyabhanusinh Chawda

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* see page 475.

5. Dr. B. Dasgupta
6. Mr. H. K. Divekar
7. Mr. David Fernandes
8. Dr. C. V. Kulkarni
9. Mr. Bansi Mehta
10. Dr. A. N. D. Nanavati, M.D.
11. Mr. M. S. Srinivasan
12. Mrs. Dilnavaz Variava

The five nominations received are :

1. Mr. M. R. Almeida
   Proposed by Mr. K. S. Gopalakrishnan
   Seconded by Mr. S. R. Nabar
2. Mr. K. D. Gokhale
   Proposed by Mr. G. L. Kalro
   Seconded by H. V. Shenoy
3. Mr. Ulhas Rane
   Proposed by M. S. Renee Borges
   Seconded by Dr. S. D. Jayawant
4. Dr. A. S. Kothari
   Proposed by Dr. M. K. Sabharwal
   Seconded by Dr. R. V. Katre
5. Mrs. Phillippa H. Mukherjee
   Proposed by Mr. G. Y. Shah
   Seconded by Dr. (Mrs.) A. S. Mehta

Agenda item (5)—Other business : Mrs. Mukherjee stated that some members find the Society's journal somewhat too technical and suggested that there may be several members prepared to waive receipt of the journal which may be coupled with reduction in membership subscription ; and therefore we should consider having two types of membership, one with the journal and second without the journal, with reduced membership rates.

Mrs. D. S. Variava suggested that a circular should be sent to all members to ask them whether they are interested in the journal and if not, whether they would waive their right to receive the journal for a stated period. The Honoray Treasurer stated that this matter had been brought up several times in the past and has been discussed by the Executive Committee also. A small reduction in the number of printed copies of the journal will not result in appreciable saving, but a reduction in membership fee may involve an overall loss of revenue, with no commensurate advantage. Prof. P. V. Bole stated that when we think of non-journal membership, we should bear in mind that outstation members of the Society are more concerned with the journal and Hornbill, since they are not able to attend meetings etc. held in Bombay.

It was decided that the Executive Committee should consider sending a communication to all members in India asking them, whether they wish to continue receiving the journal and if not, to express their waiver, and the period, so that arrangements can be made to send the journals only to those who wish to receive it and thus save on postage/delivery charges, at least.

The meeting terminated with a vote of thanks to the Chair.

In the ballot held in December 1981, the following were elected to the Executive Committee.

1. Mr. Humayun Abdulali
2. Dr. S. R. Amladi, M.D.
3. Prof. P. V. Bole
4. Mr. Divyabhanusinh Chawda
5. Dr. B. Dasgupta
6. Mr. H. K. Divekar
7. Mr. David Fernandes
8. Dr. C. V. Kulkarni, Ph.D.
9. Mr. Bansi Mehta
10. Mrs. Phillippa H. Mukherjee
11. Dr. A. N. D. Nanavati, M.D.
12. Mrs. Dilnavaz Variava

THE SOCIETY'S PUBLICATIONS

Mammals

The Book of Indian Animals, by S. H. Prater. 4th edition (reprint). 28 plates in colour by Paul Barruel and many other monochrome illustrations. Rs. 60.00
(*Price to members Rs*. 55.00)

The Ecology of the Lesser Bandicoot Rat in Calcutta, by James Juan Spillett. Rs. 10

Birds

The Book of Indian Birds, by Sálim Ali. 11th (revised) edition. 74 coloured and many monochrome plates. Rs. 60.00
(*Price to members Rs*. 55.00)

The Synopsis of the Birds of India and Pakistan, by S. Dillon Ripley II. An up-to-date checklist of all the birds resident and migrant, including those of Nepal, Bhutan, Bangladesh and Sri Lanka. 2nd edition. Rs. 100.00
(*Price to members Rs*. 80.00)

Checklist of the Birds of Maharashtra, by Humayun Abdulali. 2nd edition Rs. 4.00

Checklist of the Birds of Delhi, Agra and Bharatpur, by Humayun Abdulali & J. D. Panday. Rs. 3.00

Reptiles

The Book of Indian Reptiles By J. C. Daniel (*in press*)

Identification of Poisonous Snakes, Wall chart in Gujarati and Marathi. Rs. 5.00

Plants

Some Beautiful Indian Trees, by Blatter and Millard. With many coloured and monochrome plates. 3rd edition (Reprint). Rs. 40.00
(*Price to members Rs*. 35)

Some Beautiful Indian Climbers and Shrubs, by Bor and Raizada. With many coloured and monochrome plates. 2nd edition. Rs. 100.00
(*Price to members Rs*. 75)

Grasses of Western India, by Toby & Patricia Hodd. With 64 monochrome plates. Rs. 50.00
(*Price to members Rs*. 37.50)

Miscellaneous

Encyclopedia of Indian Natural History Edited by R. E. Hawkins (*in press*)

A Century of Natural History Edited by J. C. Daniel (*in press*)

Glimpses of Nature Series Booklets :

1. Our Birds I (with 8 coloured plates) Kannada. Rs. 0.62
2. Our Monsoon Plants (with 8 coloured plates) in Hindi and Marathi. Rs. 0.80
3. Our Animals (with 8 coloured plates) in English, Gujarati and Hindi. Rs. 1.25

Glimpses of Nature in India (with 40 coloured plates) in English Rs. 7.50
(*Price to members Rs*. 5)

Back numbers of the Society's Journal. Rates on application.

The society will gratefully accept back numbers of the *Journal*, from members who may not wish to preserve them.

TERMS OF MEMBERSHIP

Entrance Fees :

Ordinary and Life Members	Rs. 25
Student Members	Rs. 10

Subscription :

(*a*) Ordinary individual Members	Rs. 60
(*b*) Ordinary Corporate Members	Rs. 125
(*c*) Ordinary Members resident outside India	Rs. 95
Life Members	Rs. 800 (Rs. 250 after 20 years)
Compound Corporate Members	Rs. 1500
Student Members (without Journal)	Rs. 15
Annual subscription to Journal	Rs. 135

Members residing outside India should pay their subscription by means of orders on their Bankers to pay the amount of the subscription to the Society in Bombay on the 1st January in each year. If this cannot be done, then the sum of £6.50 should be paid annually to the Society's London Bankers—The Grindlays Bank Ltd., 13, St. James's Sq., London SW1Y 4LF. Account No. 1101091.

The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

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JOURNAL
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Bombay Natural History Society

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STATUS OF THE GREY WOLF (*CANIS LUPUS PALLIPES* SYKES) IN INDIA — A PRELIMINARY SURVEY[1]

S. P. SHAHI[2]

(*With three plates & two text-figures*)

In India, grey wolf is recognised as an 'Endangered Species'. Its destruction is also illegal. While other subspecies are in Appendix II, the grey wolf of the Indian sub-continent is in App. 1 of CITES. Information on the species, is, however, scanty. An attempt has been made in this paper to identify its current distribution. The habitat; ranges from the deserts of the Rann of Cutch in the west (Gujarat) with 300 mm rainfall to areas in the east (Bihar and Orissa) having approx. 1500 mm rainfall. In the south wolves occur in areas characterised by low, 400 mm, precipitation (Karnataka and Andhra), scrub forests of Rajasthan in the north with 300 mm rains have also wolves. Wolves subsist mainly on sheep and goat in desert and dry areas and prey upon hare, gazelle and blackbuck in the scrub forests of Rajasthan and ravined areas of Bihar and Orissa. Killings of humans (children) have been recorded to emphasise the urgent necessity for a deeper probe into the wolf's aberrant behaviour. A study of the Wolf's ecology, its status and population dynamics has been recommended as a prelude to suitable conservation measures for its protection.

INTRODUCTION

Wolves in India do not live in tree forests, but in open plains with occasional hills. In the course of the past fifty years substantive areas of these open plains have been used for human needs in the form of fresh villages, marginal cultivation and the wolf habitat has been systematically depleted. The table gives the names of the States in the Indian Union and the administrative districts, currently known to contain wolves (*C. l. pallipes*).

An outline map of India showing known wolf habitats with hatchings, and the States with a number in brackets accompanies this

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[1] Accepted June 1982.

[2] P. O. Hehal, Ranchi 834 005, Bihar.

TABLE

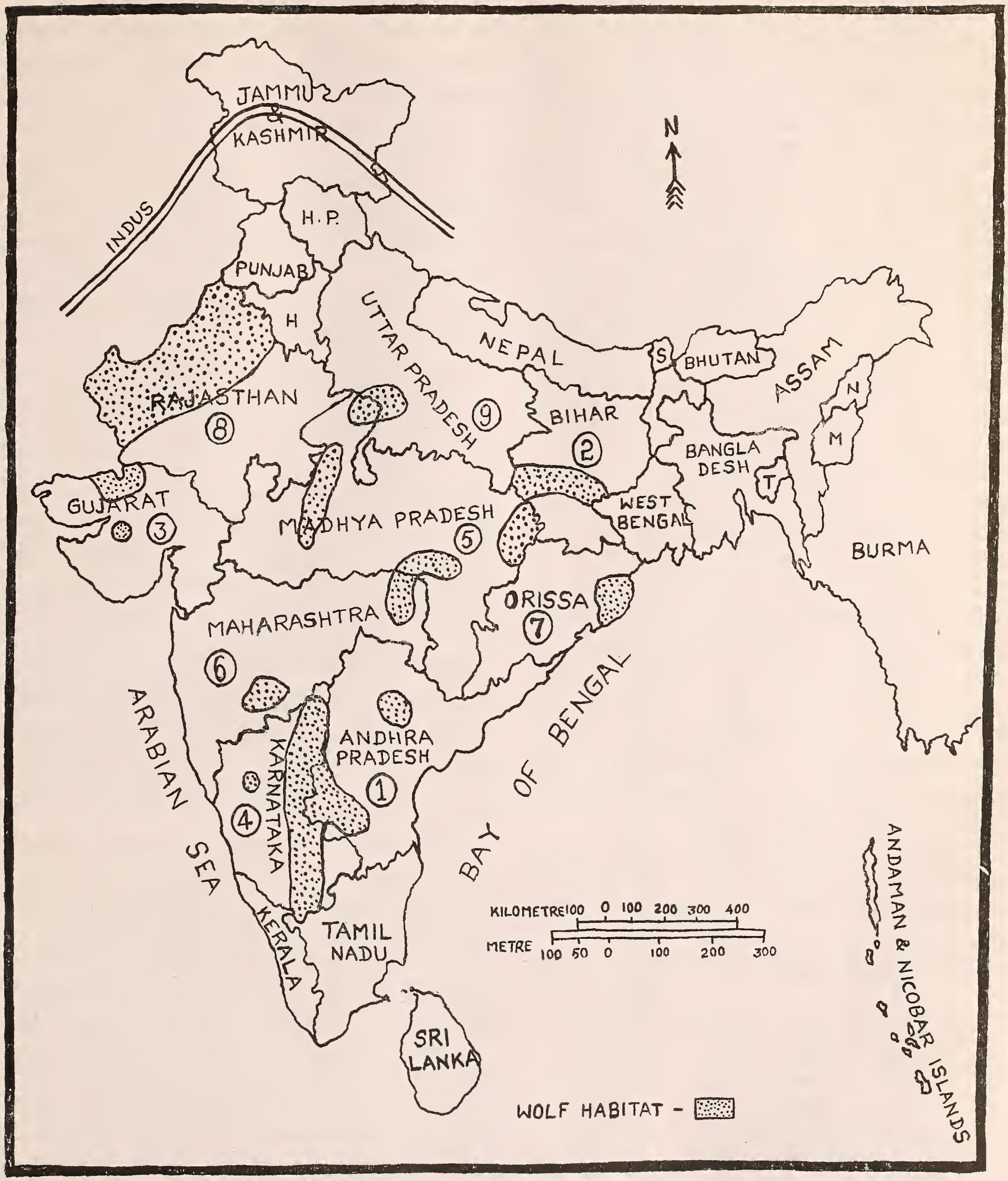
Sl. No.	Wolf holding States in the Indian Union	Localities (Civil districts)	Combined population of Sheep and goats (numbers)
1.	Andhra Pradesh	Anantapur, Karimnagar, Warangal and Mahboobnagar	8,47,544
2.	Bihar	Hazaribagh, Palamau and Dalbhum	10,47.229
3.	Gujarat	Little Rann of Cutch, Bhavnagar, Junagadh, Rajkot and Amreli	24,73,768
4.	Karnataka	Bidar, Gulbarga, Bellary, Raichur, Dharwar, Bijapur, Chitradurga and Mandya	39,44,434
5.	Madhya Pradesh	Rajnandgaon, Guna, Shivpuri, Sehore, Bhind and Morena	5,54,277
6.	Maharashtra	Sholapur, Osmanabad, Bir, Bhandara and Wardha	Not available
7.	Orissa	Dhenkanal	2,76,761
8.	Rajasthan	Barmer, Jodhpur, Jaisalmer, Nagor, Bikrampur, Sikar, Jhunjhunu, Churu, Jalori, Pali and Bikaner	1,29,40,142

paper. The number in brackets following the name of a State in the text, refers to the corresponding number on the map.

Rajasthan (8) has the highest number of sheep and goats. On either side of the common border of Andhra Pradesh (1) and Karnataka (4) wolves occur, and this wolf habitat may be regarded as one ecological unit. Together they contain the second largest sheep and goat population. There seems to be some correlation between the population of sheep and goat and the spread of wolf habitats. Rajasthan's wolf habitat is the largest with largest sheep and goat population. Andhra Pradesh (1) and Karnataka (4) together with their second largest population of sheep and goats have the second largest wolf habitat all in areas of scanty rainfall. They are marked by high temperatures and wind velocity, with scanty and erratic rainfall rendering the area perennially drought prone; 389 mm to 520 mm annual precipitation, high solar radiation exceeding 450 cal/cm per day; and dessicating winds blowing from April to August (12 to 16 km/h velocity) resulting in a high annual potential evapotranspiration of 1857 mm. Manifestation of desertification is reflected in the formation of rocky surfaces (fit for wolf dens) sand-deflation and dune formation. Wolves in some of these areas have of late behaved aberrantly by lifting children (see below). In Rajasthan too, where wolf habitat forms part of the Thar desert, it is characterised by sand dunes (fixed as well as shifting), interspersed with these dunes is the rocky piedmont plateaus and saline barren flats. I believe that Rajasthan (8), Karnataka (4), Andhra Pradesh (1), and Gujarat (3) — the Little Rann of Cutch again a very dry and saline desert area with less than 300 mm rainfall — hold the largest wolf population in the country. Such a presumption has, however, to be confirmed by intensive survey. In these areas, while agriculture sustains 80% of the population, only 10% of the net sown area is irrigated and rural economy is largely pastoral.

TAXONOMY

The Indian wolf is, indeed, a somewhat smaller and slighter animal than the Euro-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WOLF HABITAT - ▨

Fig. 1. An outline map of India showing known Wolf habitats.

pean species, the average difference in the length of the two animals being about 13 cm. Also, the hair is rather shorter and there is little or no under-fur; while the colour is generally rather more inclined to brown than in the common wolf. The absence of under-fur in the Indian wolf might, we think, be well explained by the hotter climate in which it dwells; but inspite of this, taxonomists are probably right in regarding it as a distinct species, under the name of the *Canis pallipes*. (This paper does not deal with the larger Tibetan Wolves distinguished by their long soft hair found in the snowy ranges in Ladak and Kashmir, Western Himalayas; described as a distinct species *Canis laniger* or *chanco*.)

Mendelssohn (1979) considers all the larger wolves in Israel as *C. l. pallipes*. He considers the condylobasal length of the skull (CBL) from the anterior extremity of the premaxillary to the rear extremity of the occipital condylus as the most reliable indicator of size. The mean CBL of eight male skulls in the British Museum is 212 mm with a range of 201-222 mm, and of three females, the mean is 205 mm within the range 198-214 mm (Mendelssohn). He found that the measurements of the wolves of Israel correspond with the above measurements.

Pocock, R. (1939) provides measurements (CBL) of eight skulls, six male and two female of *Canis lupus pallipes* of India. These are:

Name of locality and sex	Condylobasal length in mm
Rajasthan (8) male (adult)	212 mm
Rajasthan „ male (adult)	209 mm
Rajasthan „ female (adult)	202 mm
Rajasthan „ female (adult)	198 mm
Gujarat (3) male (adult)	205 mm
Hazaribagh (2) male (adult) (Bihar)	207 mm
Hazaribagh „ male (adult)	204 mm
Hazaribagh „ male (adult)	201 mm

In addition, I took the CBL measurements of seven skulls available in the collection of the Bombay Natural History Society. These are recorded below:

Uttar Pradesh (9) male	215 mm
Kashmir	230 mm

(This sample is of *C. chanco* from the North-West Himalayas and the CBL is much larger; this subspecies is not discussed in this paper.)

Punjab	208 mm

(This example is from a State whence the wolf is now extinct.)

Madhya Pradesh (5)	212 mm
Uttar Pradesh (9) female	179 mm
Uttar Pradesh (9) female	178 mm
Gangtok (Sikkim)	178 mm

According to authoritative sources wolves do not range into the Himalayas, and a skull from Sikkim—smallest Himalayan State of the Indian Union between Nepal and Bhutan—is an exception. The skull was collected in 1915 by the Bombay Natural History Society.

Incidentally wolf is not found westward of the Indus or in Sri Lanka. That island seems indeed to enjoy a happy immunity from the presence of several of the larger Indian carnivores as it has neither wolves, wild dogs, hyenas, nor tigers.

Two skulls of Hazaribagh wolves destroyed for the suspected killing of children in 1981 (see page) have CBLs of 210 and 215 mm. Perhaps these are of unusually large males. The mean CBL of eight male skulls, including the latest two from Hazaribagh is 209 mm with a range of 201-215 mm (excluding the *chanco* and Sikkim samples), and of the four females the mean is 189 mm with a range of 178-202 mm. Perhaps the Indian *pallipes* is slightly smaller to its Israeli counterpart though such a deduction with only a few skull samples may not be warranted.

Broadly, wolves in India, occur in two

distinct ecosystems. (A) The desert, semi-desert, and arid areas, namely those in Rajasthan (8), Gujarat (3), Karnataka (4) and Andhra Pradesh (1), and (B) Bihar (Hazaribagh, Palamau and Singhbhum) and Orissa representing the second ecological unit. The latter is characterised by higher rainfall (approx. 1500 mm) and open hilly degraded ravined forests of Sal (*Shorea robusta*).

The mean CBL of five male skulls (female skulls not available) from Hazaribagh is 207 mm and the mean of three male skulls from the desert and semi-desert areas is 208 mm. It cannot therefore be said that wolves of higher rainfall areas are either larger or smaller. Mendelssohn conclusively proves that Mediterranean wolves with over 400 mm rain are larger than those from areas with lesser rains in Israel. Such does not appear to be the case with Indian wolves.

Pelage: In general *Canis lupus* have sandy, fawn coat stippled with black. Pelt colour varies more in the wolf than in almost any other species (Mech). There is one skin in the collection of the Bombay Natural History Society from the State of Bihar, which is rufous in colour — rather an uncommon colour for *pallipes* in India.

Food

Whether it be the desert and arid areas like Rajasthan (8), Gujarat (3), Karnataka (4) or the higher rainfall areas of Bihar (2) or Orissa (7), wolves prey mainly on sheep and goat of the villagers. In blackbuck sanctuaries in Rajasthan (8) and Karnataka (4) however, where grassland is protected from cattle grazing, and the habitat has progressively improved for the antilopes, not only very rare and endangered Great Indian Bustard (*Choriotis nigriceps*) but also the wolf *Canis*

TABULAR STATEMENT SHOWING ANALYSIS OF FAECAL SAMPLES

Total No. of samples examined	No. of samples containing goat hair	No. of samples containing pig hair	No. of samples containing rat hair	No. of samples containing hare	No. of samples containing bird feathers, tails and leg bones of birds	No. of samples of which material could not be identified
130	39	56	4	10	18	3
Percentage	30	43.10	3.10	7.70	13.80	2.30

lupus pallipes co-habit with the blackbuck (*Antilope cervicapra*). The blackbuck, the bustard and wolf prefer open scrub areas and in sanctuaries of such biotic conditions, it is suspected wolves also prey upon young fawns of antilopes. The Desert National Park of Rajasthan (8) and the Ranibennur sanctuary in Karnataka (4) are examples. 100 wolf faecal samples examined in Bihar, however, indicated that nearly 70% of them contained the hair of goats and pigs and even their hoofs. Some contained feathers of birds, teeth of rats, and even claws of birds.

Indian wolves, found in small parties of half-a-dozen or so, are never known to collect in large packs. This may be explained by the fact that preying on domestic goats, pigs, and sheep, is less difficult and large packs are not needed. I have not seen more than three wolves together in the Mahuadanr valley, Bihar (2) though evidence indicated that there were eleven of them in the valley at the time (1973-74). Once while I was watching from a hide near a tethered goat, two young animals made their appearance at dusk; one of them came straight to the bait while the other stood some distance away. The first wolf put its muzzle near the goat's mouth, as if sizing up its prey, then caught it by the scruff of its neck and despatched it with one powerful snap of its jaws. It then severed the hoof from its iron fetters and disappeared into the dark with its companion. The next evening the same (?) two young wolves appeared at dusk, but this time remained waiting till a larger male arrived to make the kill. The story was repeated on the subsequent night — the three wolves appeared, but the young animals waited on the side as the larger male made the kill. There is, however, a recent case of five wolves seen together (see below).

Mendelssohn (1979) records wolves often scavenging on livestock carcasses and at garbage dumps. No observation in India on this point exists, except that unclaimed human bodies after postmortem that are buried in a slipshod manner near a morgue in the town of Hazaribagh, are eaten by wolves, besides jackals, hyenas, and dogs. Five wolves were seen by spotlight on the night of 4/5 June 1981 in this burial ground at 02.00 hrs.

Human Interactions

According to Pulliainen (1966) authentic cases of wolves stalking and killing people have occurred in Finland and Russia within recent years (Mech). In the proceedings of the Wolf Symposium in Wilmington N.C. (23-24 May 1975), Pulliainen's paper, however records differently "no evidence showing that wolves are dangerous to human beings has been obtained in Finland during this century". The general opinion in Europe and America appears to be that, except attacks by rabid wolves there is no basis for the belief that healthy wolves are any danger to human beings.

Blanford (FAUNA OF BRITISH INDIA, 1891) records "In the Dumoh district of the Central Provinces (now Madhya Pradesh) an old she-wolf and a full-grown cub haunted a patch of bushes and grass near a village standing on the slope of a hill, down which ran the main street, where children were always at play. The smaller wolf hid amongst bushes between the village and the bottom of the hill, whilst the larger animal went round to the top, and, watching its opportunity, ran down the street, carrying off a child on the way. At first the people used to pursue, and sometimes made the marauder drop his prey; but in that case the companion wolf usually succeeded in carrying off another of the children in the confusion, whilst the child first seized was generally so injured as to be beyond recovery".

The District Gazetteer of Hazaribagh (Lister, E. 1917) records "Wolves for about four years from 1910 to 1914 killed a large number of human beings near Champaran; but a special reward of Rs. 50/- (fifty) led to the hunting out of the cubs, and the evil has now ceased. They are found over the whole of the district and take considerable toll of the goats. "The statistics relating to human deaths caused by wolves in Hazaribagh as given in the Gazetteer is:

Year	No. of Humans Killed
1910	3
1911	44
1912	36
1913	21
1914	8
1915	3

A reward of Rs. 50/- was paid for each wolf killed until the end of March 1915 as against Rs. 25/- for a tiger.

Pocock, R. (1939) reports: "At Hazaribagh, as reported by Major O. A. Smith, the wolves were notorious for their man-killing propensities. Several packs terrorised the neighbourhood, and became such a curse that the Indian Government offered rewards for their slaughter. They hunted by day in pairs or small packs, displaying deadly cunning and resource, and pulling down women and children and sometimes men. The members of a pack wandered over a wide area, assembling at fairly regular intervals at particular spots.

Wolves of Hazaribagh shot into notoriety recently when a pack of five or six operated within an area of about seven sq. km. around the district town of Hazaribagh. In eight months, between February 1981 and August 1981, thirteen children were eaten away, all between 4 to 10 years of age and another 13 had close calls by wolves.

On 10-viii-1981 a wolf mauled a boy at dawn but he escaped death as some adults happened to be nearby and scared the animal away. Mention has been made earlier in the text of five wolves seen at the burial ground on the night of 4/5 June 1981 at 02.00 hrs. One of this was shot dead. Prior to this on 15th February 1980 at dusk, an animal entered a hamlet and in the process of attacking a boy attracted the attention of several elders who surrounded the intruder and killed it with wooden poles. Hamlets in this area are fenced with brushwood and the animal could not escape. One of the skulls in my possession (CBL 210 mm) is of a wolf that had been similarly surrounded by villagers on 20th August 1981 and done to death when it attacked a child of 4 years in the fenced area of the hamlet. Another wolf shot in the ravined scrub forests — this was not destroyed while attempting to kill a human — has a CBL of 215 mm was believed to be of the large alpha male that was reputed to be the killer. Villagers breathed a sigh of relief and hoped this was the end of the menace. An event that followed belied this.

On the 21st of December 1981 again at dusk, in a hamlet 6 km from the burial ground, an animal lifted a boy at dusk and ran away. The Boy's mother and uncle ran towards the animal shouting. There was another group of hamlet a little further but in the same direction in which the animal had run with the boy in its grasp. Finding men chasing him from both sides, the animal dropped the boy and leaped into the ravined scrub forests near by. I visited the spot on the 25th. There were no pugmarks on the hard ground. I also visited the hospital in Hazaribagh town in which the boy was being treated. This was the fifth day after the incidence. The photographs show the injury in the region of the boy's loin. The beast had lifted the boy, and its canines pierced the stomach above the umbilicus in front and near the spine on the back on the left flank. The distance along the curvature of the canine holes on either side measured 28 cm. The boy aged 7 years was 3′5″ in height and weighed 14.5 kg. Wolves or wild dogs hold their prey with their jaws and teeth. The tenacity of hold is their mainstay in attack. It has been made possible in the Canidae by a lengthening of the jaw bones. On the other-hand in case of the cats the canines are supported on short powerful jaws. This campa-rative shortness of the jaws gives cats that flatness of features which contrasts so markedly with the long snouts of the Canids. In this case the canines driven into the body and measuring 28 cm apart (front and back) could perhaps be only by a Canid with long jaws and not by a leopard with comparatively shorter jaws. No weight of any wolf killed in Hazaribagh (four were killed in 1981) was available. Pocock (1939) provides the following weights of three Hazaribagh *C. l. pallipes*.

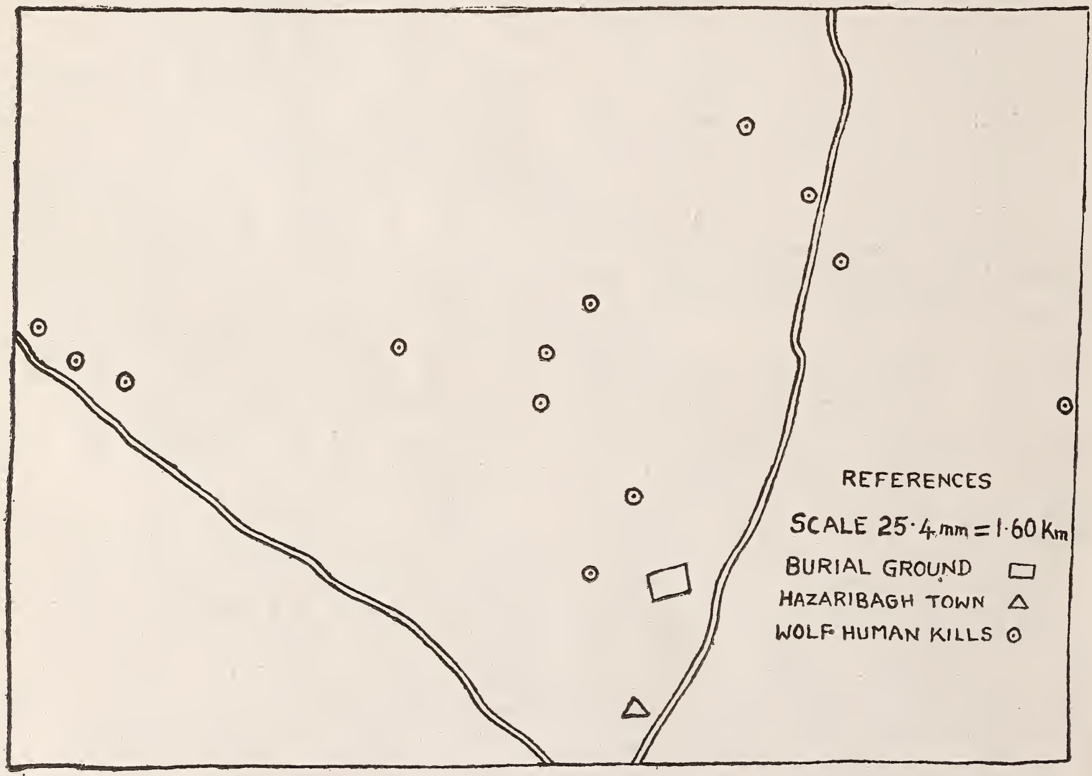
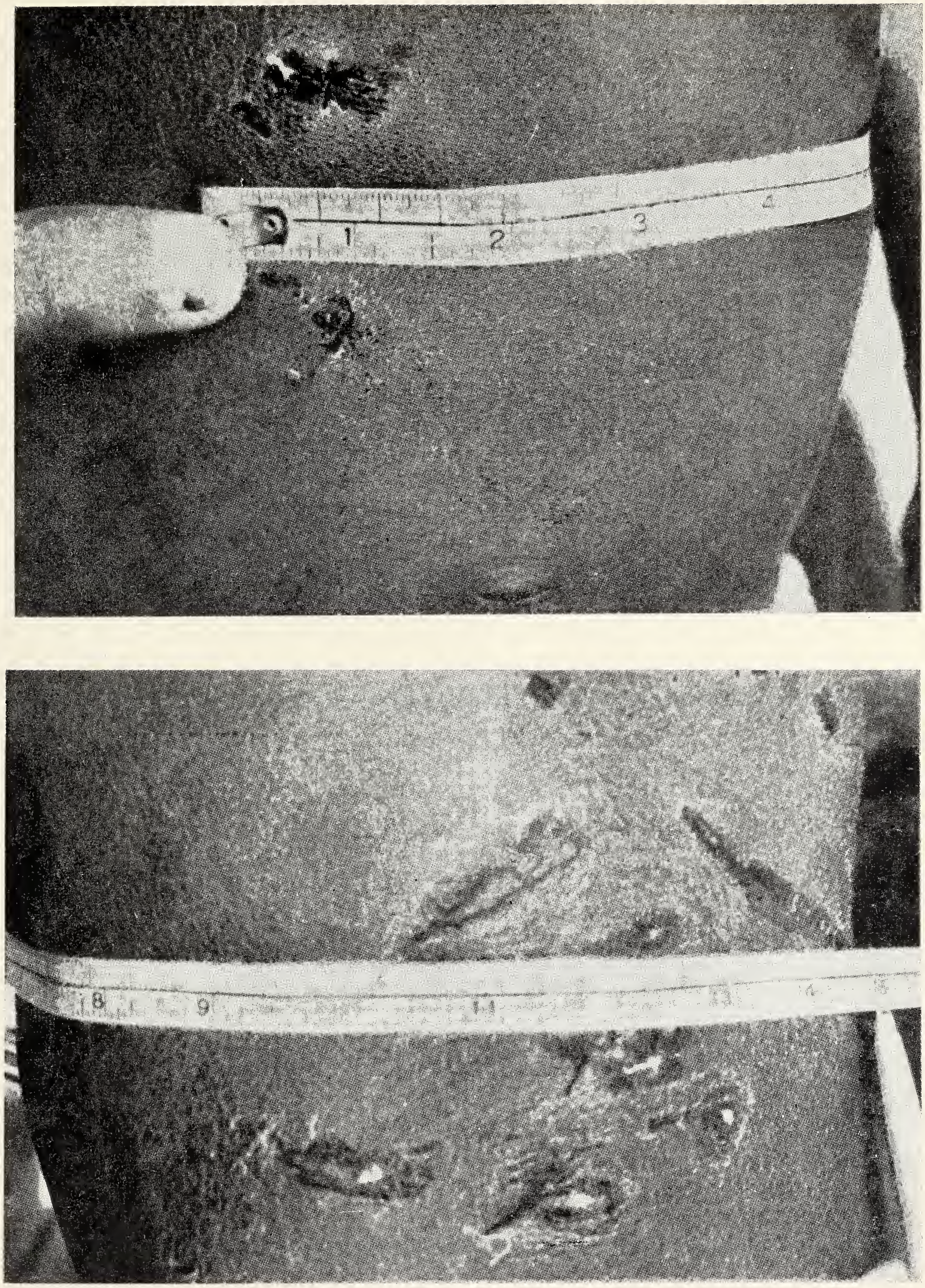
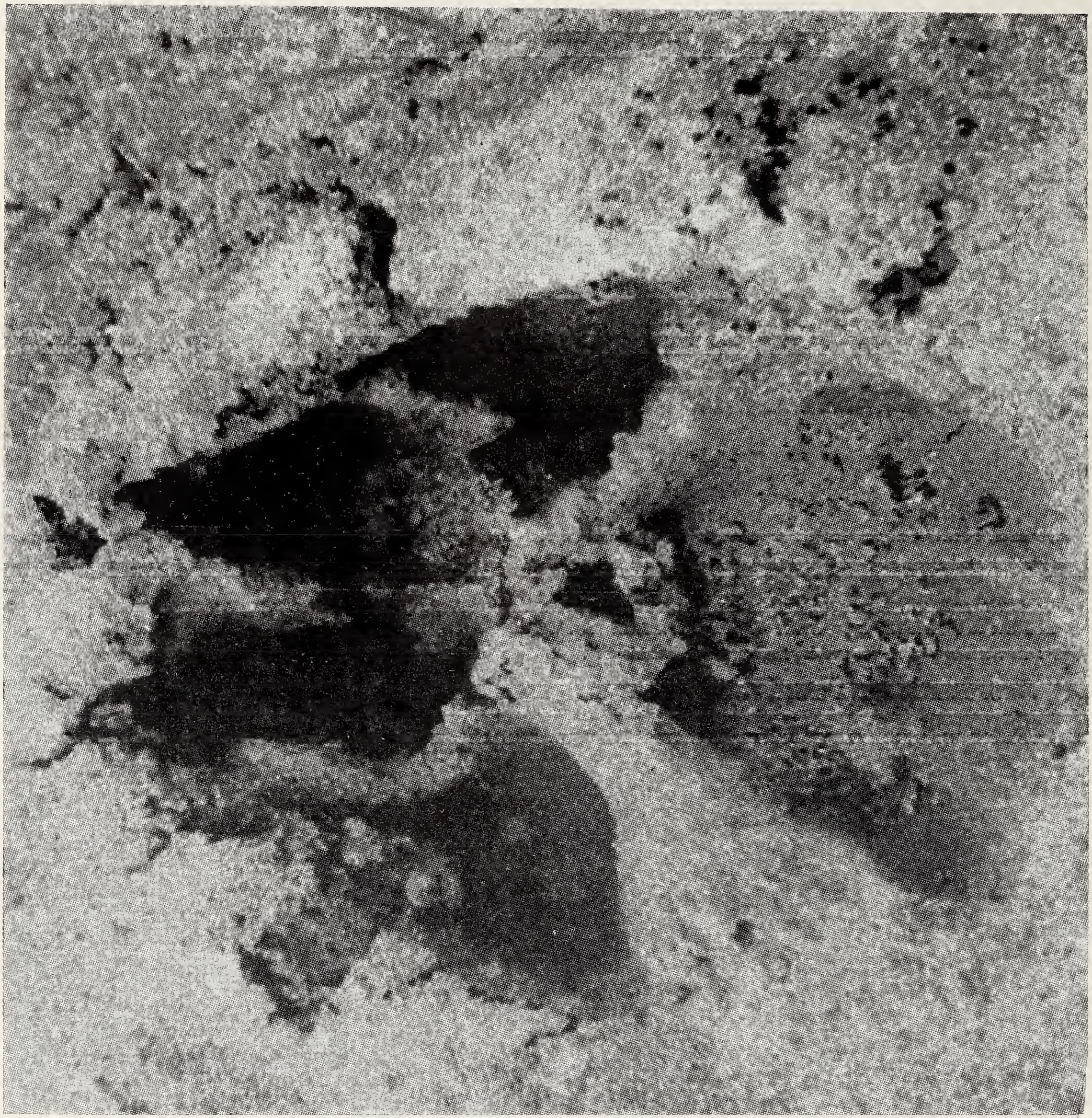


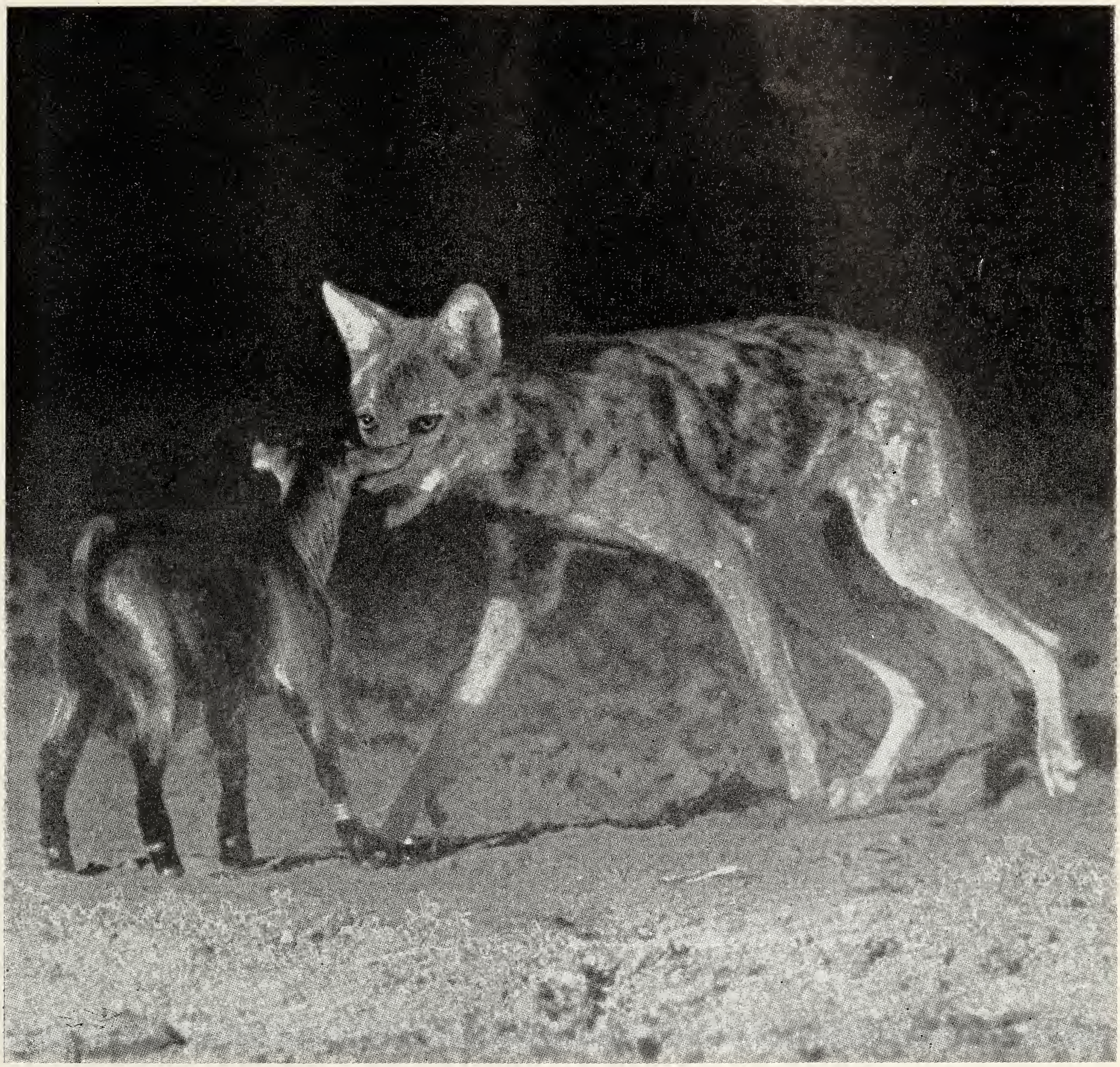
Fig. 2. Showing human kills by Wolfs around the town of Hazaribagh.



The canine marks on the ventral (up) and dorsal side of a boy mauled by a wolf. Over the curve the distance measures 28 cm. Canids have long jaws, hence this distance. Leopard will not leave marks 28 cm distance.
(Photos: *S. P. Shahi*)



Pug mark of a wolf, taken in the rains after it had dropped a child it had lifted. The non-retractile claws are clearly visible on the wet ground.
(Photo: *S. P. Shahi*)



A wolf sizes up the prey before throttling it.
(Photo: *S. P. Shahi*)

(a)	Adult Male	42 lb.
(b)	Adult Male	45.75 lb.
(c)	Adult Female	36 lb.

The average weight of an adult male works out to 19.75 kg. Probably a 20 kg wolf could not carry a boy of 14.5 kg weight for a long distance and that too when chased, and so dropped the boy about 200 metres away.

3500 km down south of Hazaribagh, in a altogether different ecological niche in the State of Andhra Pradesh (1) about the same time the wolves had terrorised villagers in Hazaribagh; a pack of wolves consisting of one male, two adult females, two semi-adults and three cubs operated in an area 30 km long and 25 km wide. Nine children were killed, another twelve injured between October 1980 and March 1981. The victims were in the age of 8-12. It was not possible for me to visit the area but the report of the local Forest Officer reads: "The *modus operandi* shows that the attacking wolf was generally hiding in a bush or amidst crops in agriculture fields near the villages and pounced upon the unsuspecting children coming near them. They were generally attacked from behind. The victim was pushed down and the animal bit the neck and skull of the children to kill them. The skull was opened first and brain eaten by the animal, and if sufficient time was available, the animal ate other parts of the body. Children when accompanied by their elders, were not attacked. It was found that all the adult members of the pack of wolves, were killers of children. The method adopted by the wolves, and their timings (either dusk or dawn) for killing children was the same both in Bihar (2), Hazaribagh, and Andhra Pradesh (1) two widely separated States of India.

All wolf-holding States are not menaced by such aberrant behaviour. In Rajasthan (8) killings of humans are an exception. So is the case in Melekote Wolf Sanctuary in Karnataka (4), which I visited in April 1981. The countryside is a picture of barren and denuded hills with eucalyptus plantations in the folds of hill ranges. In two villages, Aralkare and Kattahali, there are 10,000 sheep and goats. Some 250 of these are taken away by wolves every year. A pair had, about the time of my visit invaded a pen and slaughtered without logic a number of sheep which, of course, they did not carry away. The Melekote villagers have, however, taken wolf depredations as an occupational hazard. Maniappa, a villager said that in his life span of sixty years he had not heard of any human being killed, not even a child". In Gujarat (3) where there are some sixty wolves in the Rann of Cutch, there is no case of child killing in living memory. In Surendranagar district in which the Rann falls there are over 2,25,000 (two hundred and twenty five thousand sheep and goats) and the sixty wolves live on them. In Bihar (2) too while Hazaribagh has been notorious for wolf menace, in the other wolf habitat in the State — the Mahuadanr Valley — there is no child killing. In their home range of about 50 sq. km in this valley villagers own 3000 (three thousand) goats and 2000 (two thousand) pigs. 200 goats and 300 pigs are lifted every year. The analysis of scats is from this valley. As in Melkote, Mahuadanr villagers have taken wolf predation as an occupational hazard. Some villagers were, infact, of the opinion that wolves protected their upland agriculture crops by scaring away wild boar that would otherwise dig out the plants. The position is that at the moment except Hazaribagh in Bihar, and on the Common border of Karnataka and Andhra Pradesh wolves are not known to attack humans.

CONCLUDING REMARKS

It is likely that wolves occur sporadically in areas other than those shown in the map. Though the species is protected by law and no bounty is paid for its extermination now, in many parts shephards either club them to death or poison them. Cubs are either dug out or smoked out and destroyed. It has not been possible to effectively enforce the law that protects the wolf. No one has the remotest idea as to how many wolves really survive in this country. Some 35 (thirty five) are reported from Rajasthan, 50 to 70 (seventy) exist in Karnataka (4), about 30 (thirty) in Bihar (2), and some sixty in the Little Rann of Cutch, Gujarat (3). Nothing is known about their number in Madhya Pradesh (5), Andhra Pradesh (1), Maharashtra (6), Orissa (7) and Uttar Pradesh (9) though they have been sighted in these States too. Perhaps not more than 500 to 800 (eight hundred) wolves, in small packs of five to six animals survive in India.

The future of the species lies in (a) a survey to locate viable wolf populations in different ecological conditions; (b) a study of its aberrant behaviour and other aspects of its ecology by modern techniques (namely radio tracking); (c) a declaration of viable areas as Wolf Sanctuaries with scientific management plans and provision for compensation to herdsmen for loss of their livestock, and (d) an introduction of prey animals like blackbuck, axis deer and wild boar in wolf sanctuaries. Potential areas for sanctuaries are available in Bihar (2), Andhra Pradesh (1), Karnataka (4), Rajasthan (8) and Gujarat (3).

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FORAGING BEHAVIOUR AND INTERACTIONS OF WHITEHEADED BABBLERS *TURDOIDES AFFINIS* WITH OTHER SPECIES[1]

A. J. T. JOHNSINGH,[2] K. PARAMANANDHAM AND S. MURALI[3]

(*With three text-figures*)

Whiteheaded Babblers were studied from 14th August 1979 to 7th April 1980 in a 0.2 km² partly cultivated land near Sivakasi (9°27'N., 77°49'E.) in South India. Their density in the study area was 55/km², home range of the study group was 0.16 km² and mean home area 0.06 km².

We saw neither cooperative hunting nor food sharing between adults even when large prey (e.g., a big green grasshopper) were killed and eaten. The babblers foraged mostly on ground and fed mainly on animal matter (> 80%). During dry months they intensively foraged in a small part of their home range but covered greater distance and were active at midday too. They spent more time in areas where water, food and shade were abundant.

We observed a mutually beneficial association between Black Drongo *Dicrurus adsimilis* and the babblers. Shikra *Accipiter badius* aroused most of the anti-predator responses. Redvented Bulbul *Pycnonotus cafer* and Indian Wren-Warbler *Prinia subflava* were allowed to feed within 5 m. We hypothesize that this tolerance is due to differences in foraging.

INTRODUCTION

Of the nine species of *Turdoides* in India the Jungle Babbler *Turdoides striatus* and the Common Babbler *T. caudatus* have been studied extensively (Andrews & Naik 1970, Gaston 1977, 1978b). Whiteheaded Babblers *T. affinis*, which have many of the characteristics of cooperative breeders (Emlen 1978) are distributed from the Godavari and Penganga rivers and Western Karnataka from Belgaum area south through Tamilnadu and Kerala (Ali & Ripley 1971). However, except for the ongoing comparative study of the ecology and behaviour of the Jungle and Whiteheaded Babblers in Calicut (as reported in Zacharias & Mathew 1977) little work has been done on Whiteheaded Babblers.

It has been well established that the most important feature of vegetation for birds is structure rather than species composition (Gaston, *pers. com.*). We, however, initiated the study to find whether variation in vegetation density, size of foraging areas and number of roosting and nesting sites influence the time spent by the babblers in different parts of their home range. Interactions with other species were also recorded.

STUDY AREA

The habitat has a dry stream bordered by vegetation on either side. Approximately half of the study area was cultivated by water

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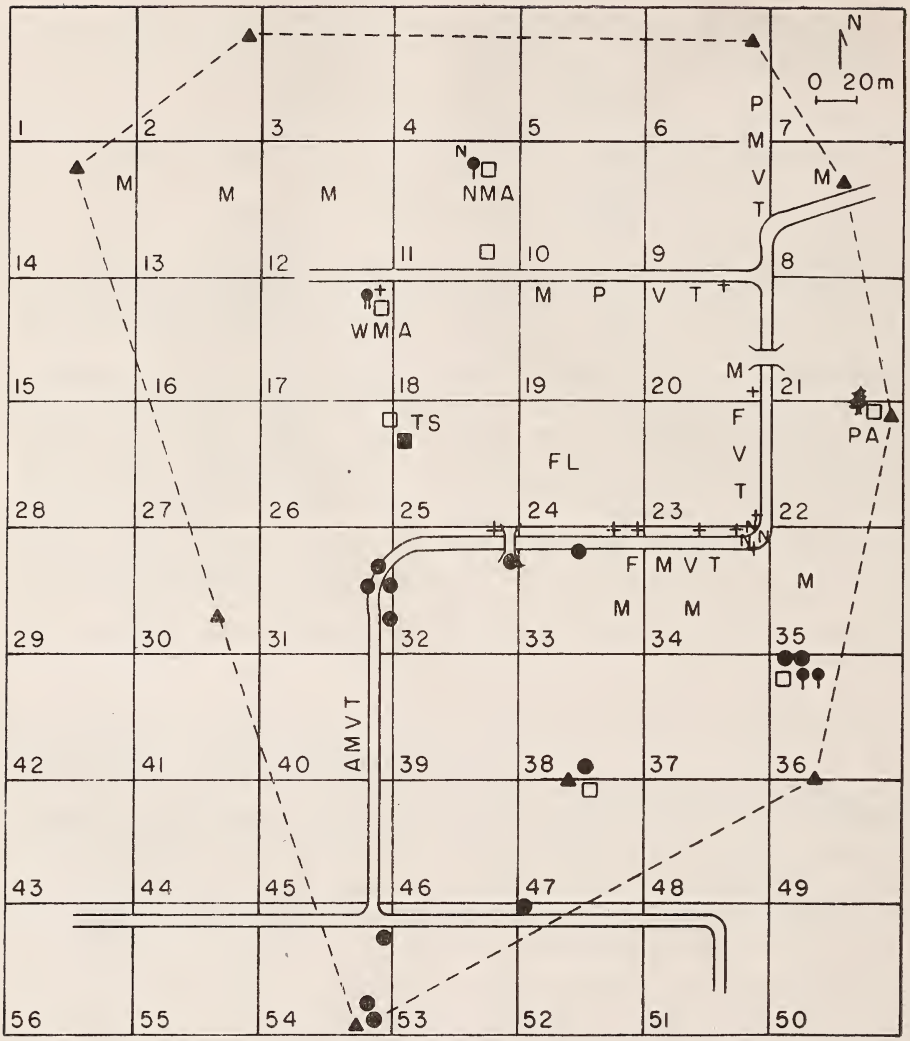
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Fig. 1. Map of study area showing various vegetation types, home range of the study group & other details. August 1979 to April 1980. AMVT, FMVT, FL, etc. = various vegetation types or foraging areas. (See Table I) □ = well, ■ = tomb, ▲- -▲ = home range boundary of study group, ● = place where group of 8 was seen, + = major roosting site, N = nesting site,)(= stone wall across stream bed, 1-56 = quadrat numbers, ═ = stream bed, M = miscellaneous foraging sites.

TABLE 1

DETAILS OF THE MAJOR VEGETATION TYPES OR FORAGING AREAS SEEN IN THE STUDY AREA

Vegetation types or Foraging areas	Area in m^2	Vegetation density	Relative density of numerically abundant plant	Nesting site	Roosting site	Water	Area under shade	in quadrats
Agave-Morinda Vegetation Type (AMVT)	2640	0.49	*Agave americana* 37.5%	Nil	One	No perennial water	> 60%	31,32,40,45
Fallow Land (FL)	4000	0.05	*Morinda tomentosa* 85%	Nil	Nil	,,	< 10%	23,24,25
Fluggea-Morinda Vegetation Type (FMVT)	1800	0.55	*Fluggea leucopyrus* 36%	Three	Nine	,,	> 70%	33,34
North Mango Area (NMA)	600	0.19	*Morinda tomentosa* 64%	One	Nil	Perennial water (Well)	> 80%	11
West Mango Area (WMA)	375	0.22	*Morinda tomentosa* 70%	Nil	One	,,	> 70%	17
Morinda-Fluggea Vegetation Type (MFVT)	1300	0.40	*Morinda tomentosa* 38%	Nil	Three	No perennial water	> 60%	20,21,22,23
Morinda-Prosopis Vegetation Type (MPVT)	1700	0.40	*Morinda tomentosa* 34%	Nil	One	,,	> 70%	9,10,11,18, 19,20
Polyalthia area (PA)	900	0.097	*Morinda tomentosa* 49%	Nil	Nil	Perennial water (Well)	> 60%	22
Prosopis-Morinda Vegetation Type (PMVT)	1200	0.27	*Prosopis juliflora* 37%	Nil	Nil	No perennial water	> 70%	6, 7, 8, 9
Tomb Site (TS)	1600	0.095	*Morinda tomentosa* 83%	Nil	Nil	,,	< 10%	25,26

drawn from wells and other areas remained fallow except during north-east monsoon. We divided the study area into 56 quadrats of 60 m² each and based on the numerically abundant plants, their associations and terrain distinguished many vegetation types (Fig. 1). Table 1 gives details of the vegetation types.

The study group had 11 babblers and besides these there were two groups of 8 and 5 in the neighbourhood. The birds which interacted with the babblers are Black Drongo *Dicrurus adsimilis*, Shikra *Accipiter badius*, Crow Pheasant *Centropus sinensis*, Jungle Crow *Corvus macrorhynchos*, House Crow *Corvus splendens*, Tree Pie *Dendrocitta vagabunda*, Spotted Owlet *Athene brama*, Blue Jay *Coracias benghalensis*, Indian Myna *Acridotheres tristis*, Brahminy Myna *Sturnus pagodarum*, Koel *Eudynamys scolopacea*, Pied Crested Cuckoo *Clamator jacobinus* and the Grey Partridge *Francolinus pondicerianus*.

Mammals of the area are Threestriped Palm Squirrel *Funambulus palmarum*, Blacknaped Hare *Lepus nigricollis*, Common Mongoose *Herpestes edwardsi* and Jungle Cat *Felis chaus*. Reptiles seen were the Cobra *Naja naja*, Russell's Viper *Vipera russelli* and the Rat snake *Ptyas mucosus*.

METHODS

The Whiteheaded Babblers have feeble powers of flight. The maximum distance a bird covered in a non-stop flight was *c.* 180 m. Before flying from one area to another usually they go up a tree or tall shrub to gain height in flight. Hence it was possible to mark their foraging route and the rate of movement as they moved from one vegetation type to another.

Babblers were located mostly by their excited calls audible for > 200 m even against wind. Whenever we decided to follow the group from the time they left the roost, we located and followed them till they roosted in the evening. Next day around 0530 hr we waited for them to commence activities. Data on the foraging routes and the rate of movement was collected once a month from August 1979 to March 1980 and the group was followed from the onset of their activity till they roosted. The babblers did not always move as a group as 2 or 3 birds sometimes lagged behind. In such cases we followed part of the group which had more members and never less than seven. As we were careful not to disturb the foraging route, we did not go close to the group. This and the habit of the babblers feeding in the interior of the shrubbery made it difficult to identify all food eaten.

RESULTS

Density and home range

Whiteheaded Babblers are cover-dependent for escaping predators. This reliance prevents them from occupying the vast stretches of tree and shrubless plains around Sivakasi. The habitable area for the three groups, including the study area, was around 0.4 km² which gives a density of 60 birds per km². The density for the study area was 55 birds per km² and the home range of the study group was *c.* 0.16 km².

This home range was not covered when day range length for 8 days was computed (Fig. 2) and for the estimation of home range data collected on other days were also used. The home area (area covered on single day — Madison, 1978) for 8 days ranged from 0.024 to 0.099 km², with a mean of 0.06 km².

Normally distance between neighbouring groups was between 100 and 200 m. Twice group of 11 went deep into the home range of group of 8 when the latter was not in that area and once the group of 8 made an inroad into the home range of group of 11 when the latter was feeding *c.* 200 m away. Six observations showed that group of 5 did not have a fixed home range and lived along the periphery of north-western and south-eastern parts of the study area.

Intergroup conflicts were seen on 4 occasions — thrice between group of 11 and 8 and once between group of 11 and 5. Conflicts were characterized by chases between individual birds and loud vocalization. Physical attack on the intruder was seen twice.

Foraging behaviour

The babblers commenced feeding *c.* 20 minutes before sunrise. In a foraging site they moved in different directions and there was no incidence of either cooperative hunting or food sharing between adults even when large prey (e.g., a big green grasshopper) were killed and eaten. Only once we saw a babbler chasing an insect flushed by another. A babbler at a static food source like a termite

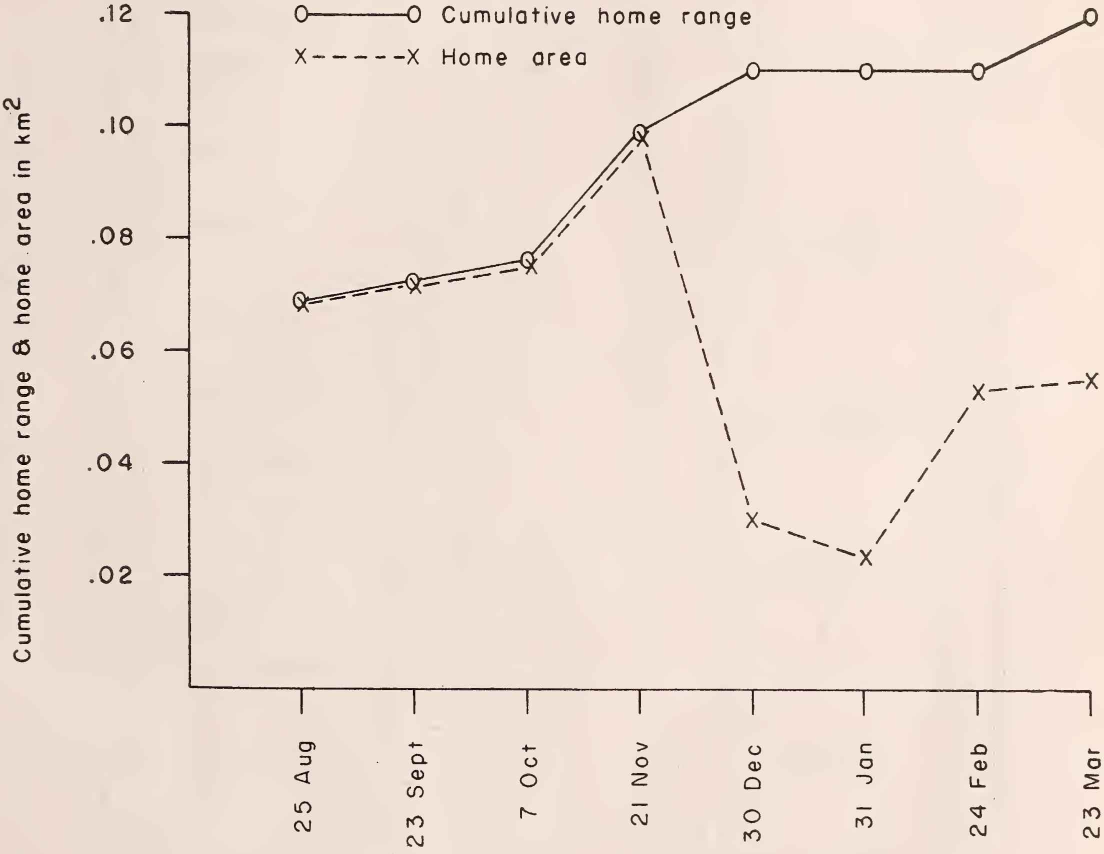

Fig. 2 Cumulative home range and home areas of the study group (25 Aug. 1979 – 23 Mar 1980)

TABLE 2

ACTIVITIES OF BABBLERS ASSOCIATED WITH FEEDING ON GROUND BASED ON 77.39 MINUTES OBSERVATION THROUGHOUT THE STUDY AT DIFFERENT TIMES OF THE DAY

Activities	Hopping	Standing ground gleaning	Object overturning gleaning	Ground sally gleaning	Short flight	Ground hawking	Flutter pursuit	Leaf clinging gleaning
Number of times seen	1388	435	127	13	10	3	1	1

TABLE 3

ACTIVITIES OF BABBLERS WHILE IN TREE BASED ON 52 MINUTES OBSERVATIONS THROUGHOUT THE STUDY AT DIFFERENT TIMES OF THE DAY

Activities	Auto preening	Allopreening	Beak cleaning	Both leg stretch	Both wing stretch	One wing stretch	Defecation	Hopping	Oiling	Ruffling	Short flight	Tail shake	Wing shake	Vocalization	Food begging	Foliage gleaning
Number of times seen	446	4	28	1	1	1	4	87	9	15	10	34	28	4	1	64

colony attracted others and 3 to 5 formed a circle and ate.

The following classification of the foraging methods of babblers is based on the study of Neotropical Tyrant Flycatchers (Fitzpatrick 1980). Hopping was the major method of movement on the ground (Table 2). Standing ground gleaning (catching prey standing on the ground) was the most common method of prey capture. Frequently the babblers overturned leaves and sticks on the ground (Object overturning gleaning). In such cases it was not possible to differentiate pecking at prey from eating. Prey was picked from vegetation during a short jump or flight (Ground sally gleaning) or snatched from air (Ground hawking). Rarely insects attached to the leaf were removed and while doing so the birds momentarily clung to the leaf-tip (Leaf clinging gleaning). Low flying insects were rapidly pursued in flight (Flutter pursuit) and the babblers with remarkable agility twisted and turned in the air. Foraging was frequently seen in foliage (Table 3). While tearing apart large prey like grasshoppers or *Morinda* fruit (*Morinda tomentosa*) or while plucking grain from an earhead a foot was used to press down the food.

Babblers fed mostly on insects and caterpillars (Table 4). While foraging they moved frequently but the distance covered and speed of movement varied on different days (Table 5). Average speed of movement for September, October, and November, the rainy months, characterised by dense vegetation and fruit abundance was around 105 m/hr and the data for January, February and March, part of the dry season, was around 134 m/hr. The abundance of grasshoppers, a common prey, varied little between rainy and dry season. Grasshoppers counted along the foraging path on 2nd October were 155 and on 7th

TABLE 4

TYPES OF FOOD EATEN BY THE BABBLERS DURING THE STUDY

Type of food eaten	Insects		*Sorghum vulgare*	*Morinda tomentosa*	*Fluggea leucopyrus*	Centipede	Spider	Grub
	Adults	Caterpillars						
Times seen	29	22	6	5	3	2	1	1

TABLE 5

FORAGING DISTANCE AND SPEED OF MOVEMENT OF THE BABBLERS

Date	Total foraging time (in hours and minutes) h.	m.	Total distance covered (in metres)	Speed of movement (metres per hour)
25.viii.'79	12	35	3000	239
23.ix.'79	12	34	1370	109
7.x.'79	12	32	1040	83
21.xi.'79	12	08	1500	124
30.xii.'79	12	12	1720	141
31.i.'80	12	08	1620	134
24.ii.'80	12	16	1600	130
23.iii.'80	12	38	1760	139

TABLE 6

SPEED OF MOVEMENT OF THE BABBLERS IN METRES IN DIFFERENT TIMES OF THE DAY

Date	Before 1000 hrs.	Between 1000-1400 hrs.	After 1400 hrs.
25-viii-79	308	318	146
23-ix-79	187	91	60
7-x-79	110	68	79
21-xi-79	79	162	160
30-xii-79	118	125	193
31-i-80	207	140	83
24-ii-80	212	135	78
23-iii-80	196	105	145
Total	1417	1144	944
$\overline{X}$	177	143	118

April, 169. The Mann-Whitney U-test showed that the babblers covered more distance during the dry season ($U = O$, $p < 0.05$) but foraged in a restricted part of their home range (Fig. 2). More distance covered by babblers in dry season may be correlated with lack of fruits. In Sivakasi, where the summer temperature in day time rises to 40°C, one may expect the babblers to cover more distance in early morning and evening and remain inactive at midday. The distance covered by the babblers and their speed of movement between 1000 and 1400 hr were not significantly different from data for hours between the onset of foraging and 1000 hr (Table 6).

If the time spent by the babblers in different vegetation types is calculated, with references to the area of vegetation types, it was seen that the babblers spent more time (8.61 hr) in the north mango area (see Table 1 and 7). This area until the end of November had banana plants (*Musa paradisiaca*) and throughout had abundant food perennial water. The *Fluggea-Morinda* vegetation types (Tables 1 and 7) comes as the second most intensively utilized area and the reason for this is the combined effect of the presence of nesting sites, roosting sites, vegetation density and shade. During November and December in this vegetation type the babblers fledged a cuckoo chick and in January and February 2 babbler chicks were raised. During the breeding season the group spent 13.07 hr in *Fluggea-Morinda* vegetation type and in non-breeding reason 10.12 hr. Total hours of observation for the breeding and non-breeding season was 48.73 hr and 50.19 hr

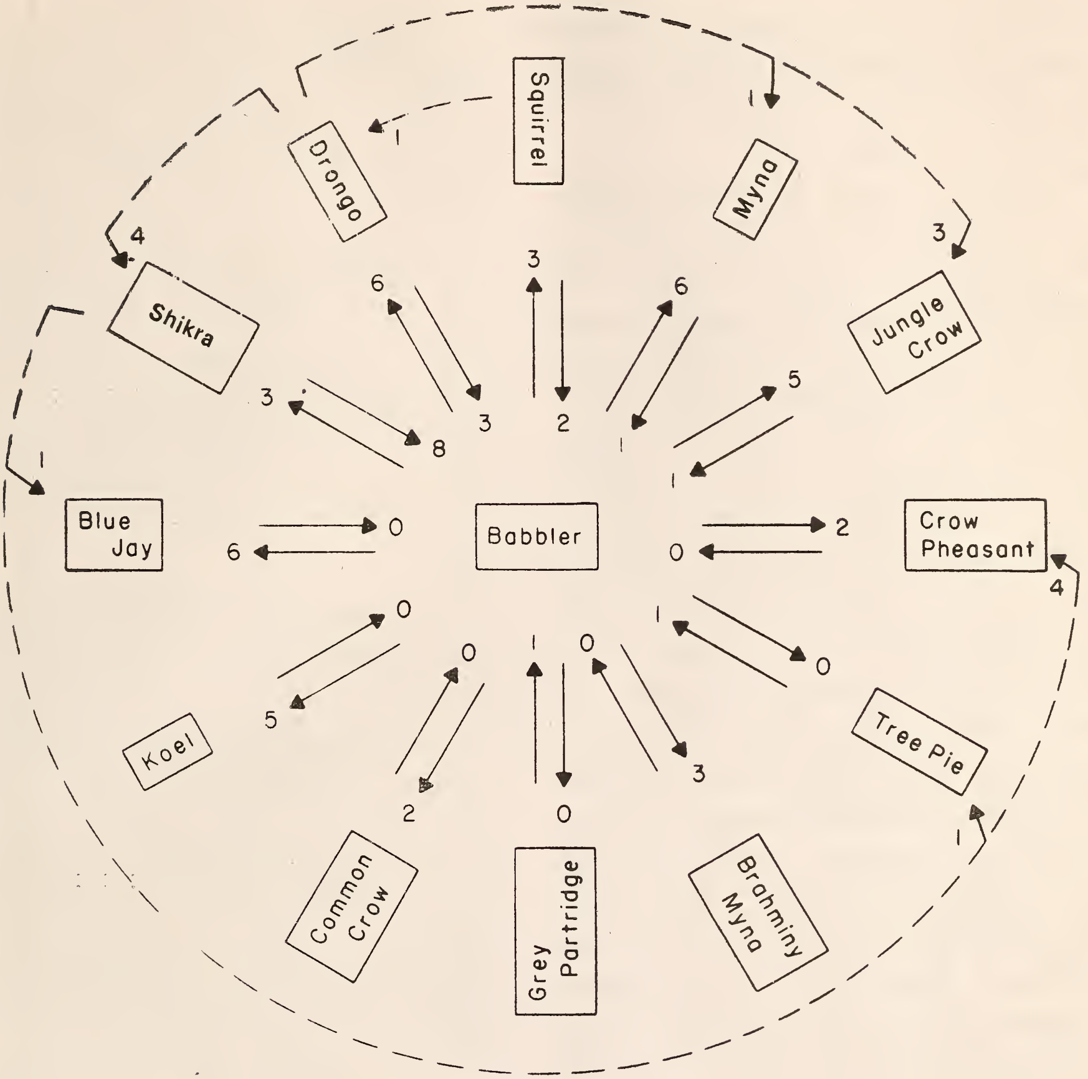
Squirrel
Drongo
Myna
Jungle Crow
Shikra
Blue Jay
Babbler
Crow Pheasant
Koel
Tree Pie
Common Crow
Grey Partridge
Brahminy Myna
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Fig. 3 Aggressive interactions between Babblers & other animals of study area. August 1979 to April 1980.

Note: Babbler ⟶ 6 Drongo = Babbler chased Drongo six times.

respectively. The time spent by the babblers in this vegetation type during the breeding season was not significantly different from the time spent during the non-breeding season ($t = 0.56$, $df = 3$, $p = > 0.05$).

Interactions with other species

There were 32 sightings of drongo feeding with the babblers. Drongo was one among the three birds — the other two being the Red-vented Bulbul and the Indian Wren-Warbler, which were tolerated to feed within 5 m, when the group raised cuckoo and babbler chicks. This suggests a mutually beneficial association between the drongo and babblers as the aerially hawking drongo benefited by capturing insects flushed by the babblers (4 observations). It even robbed a grasshopper from a babbler. No other bird except a babbler was seen chasing a drongo (Fig. 3), but drongo chased off all predatory birds. When the group had chicks, there was no incidence of the drongo being chased off by the group. Babblers, therefore, may tolerate drongo's presence, especially, when chicks are present as the latter gives protection from predators. Presumably the benefit outweighs the cost to babblers of having food robbed occasionally.

The babblers responded to predators and other fear-stimulating objects in different ways (Table 8). Shikra was the commonest predator which elicited most of the anti-predator responses. Alarm is the short shriek-call and as the call was given the babblers flew to cover. A hare in the bush, Crow-Pheasant and a shed snake skin also made the babblers to sound alarm. Excited calls sometimes lasted for more than 4 minutes and mobbing call could be differentiated from an excited call when two or more babblers called on seeing a predator. The Blacknaped Hare feeding in open did not excite babblers. Once the group lost its interest in a 2 m active snake after mobbing it for 4 minutes. Spotted Owlets were tolerated

TABLE 7

TIME SPENT BY THE BABBLERS IN HOURS AND MINUTES IN DIFFERENT VEGETATION TYPES WHILE FORAGING

Vegetation Types	*Agave-Morinda*		Fallow Land		*Flueggea-Morinda*		North Mango		West Mango		*Morinda-Fluegga*		*Morinda-Prosopis*		*Polyalthia* area		*Prosopis-Morinda*		Tomb site		Miscellaneous foraging sites	
Dates	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
25-viii-79	1	18	..		3	37	—	34	—	20	—	36	2	26	..		2	59	..		—	45
23-ix-79	2	09	..		1	05	3	13	—	34	—	41	1	30	—	16	1	17	—	06	1	43
7-x-79	..		..		1	31	4	34	—	38	1	30	3	21	—	21	..		..		—	37
21-xi-79	3	14	..		1	20	—	16	—	26	1	48	1	35	—	45	1	24	—	57	—	23
30-xii-79	2	39	..		1	49	..		..		1	18	4	49	..		1	37	..		..	
31-i-80	1	48	—	52	6	22	..		..		—	49	—	06	..		1	38	..		—	33
24-ii-80	2	53	—	08	3	33	..		2	36	—	02	—	58	—	29	—	40	—	38	—	19
23-iii-80	1	39	—	17	3	54	..		—	30	1	39	—	08	..		1	46	1	18	1	27
Total	15	40	1	17	23	11	8	37	5	04	8	23	14	53	1	51	11	21	2	59	5	47

TABLE 8

VARIOUS ANTIPREDATOR BEHAVIOUR OF WHITEHEADED BABBLERS OBSERVED DURING THE STUDY

Types of behaviour	Alarm call	Excited call	Mobbing	Hiding in cover	Chase
Number of times observed	38	17	10	14	41
Prominent causative agents	Shikra	Observer	Shikra	Shikra	Shikra, Blue Jay, Myna

except for one incident of babblers mobbing an owlet when they had the cuckoo chick. Jungle Babblers are known to chase Spotted Owlet (Andrews & Naik 1970).

DISCUSSION

Density of babblers reported in this study is not high when compared with the density of other species of *Turdoides* (1067 Jungle Babblers per km² (Andrews & Naik 1970), 133 Striated Babblers per km² [Gaston 1978 (a)]; 46 Common Babblers per km² [Gaston 1978(b)]. Lack of dense vegetation entirely covering the study area with fewer nest sites and lower food abundance may be the reason.

Insectivorous birds foraging in flocks can beat up a higher proportion of flying insects per bird than can scattered individuals (Wilson 1975). Whiteheaded Babblers did not show this trait. In the absence of cooperative foraging, group living in babblers may help them detect predators as in doves (Siegfried & Underhill 1975) but an optimum size of the group is necessary to deter predators. We observed that a group of three babblers was not successful in chasing off a shikra but nine did it effectively. Movement from one area of the home range to another, a characteristic of many territorial species, is not only for optimization of foraging (Charnov *et al.* 1976) but also for patrolling their territories to keep away conspecifics (Gaston, *pers. com.*).

Since babblers mostly feed near or on ground, we call them near ground foragers and drongos, aerial hawkers. This foraging difference reduces competition for food. The adaptive value of mixed species flocking in birds is generally held to be connected with feeding advantages, protection from predators or both (Morse 1970). The babbler-drongo association is another example.

Babbler's interactions with other species provide examples for interspecific conflict related to predation, roosting site and food resources. Of the 10 species chased off by babblers (Fig. 3), four species (Jungle Crow, Shikra, Crow Pheasant and House Crow) were potential predators of babbler chicks. All interactions with Blue Jay were observed at roost sites. Birds, such as, Indian Myna, Brahminy Myna and Koel probably compete for the same food resource. Low (1971) found that 35 of the 38 species, that were chased off by pomacentrid fish *Pomacentrus flavicauda,* were food competitors, while all of the 16 species that were allowed to trespass unmolested exploited different food resources. Redvented Bulbul and Indian Wren-Warbler, which probably do not compete with babblers for the same food resource and which cannot harm babbler chicks, were tolerated at all times and the drongo was not chased off when chicks were present. This implies that babblers know what and when to chase off from their vicinity. A proper understanding of this will be evident by further studies on this aspect.

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STUDIES ON THE GRASSES OF KHERI DISTRICT, UTTAR PRADESH[1]

K. K. SINGH[2]

This paper gives an account of the grasses of Kheri district. A Dichotomous Key to the genera of Poaceae is included. Fifty four genera and seventy seven species are described. Ecological notes, phenology, local names and field numbers are provided to the species.

INTRODUCTION

Kheri district in north Uttar Pradesh lies between 27°41′ and 28°42′N. latitude and 80°2′ and 81°19′E. longitude. The district is separated on the east from Bahraich district by river Kauriala, and has to its south Sitapur and Hardoi districts and, Shahjahanpur and Pilibhit districts to the west, and Nepal to the north, separated by Mohan river (Anon. 1927). The thick forest belts of the district are situated in the terai regions of the foot hills of Himalayas. The grasslands are well represented in between the sal forest of the district and are locally known as *Phantas*.

Seventy seven species of grasses occur in this region. Ecological notes, phenology, local names, occurrence, field numbers etc. have been recorded for the species enumerated.

KEY TO THE GENERA OF FAMILY POACEAE
(*nom. alt. Gramineae*)

1. Culms woody with culm sheath (reduced leaves) .... *Dendrocalamus*
1. Culms not woody; leaves not reduced to culm sheath:
    2. Spikelets of two florets, the upper perfect and the lower staminate or neutral and usually falling off entirely together with glumes at maturity:
3. Male and female spikelets in separate inflorescence:
4. Plant glabrous or slightly hairy; caryopsis enclosed in stony bracts .... *Coix*
4. Plant hairy; caryopsis enclosed in thick lower glumes .... *Chionachne*
3. Spikelets all hermaphrodite with male or barren or hermaphrodite spikelets mixed in the same inflorescence:
5. Spikelets often paired; with one sessile and other pedicelled, glumes as long as the spikelets; upper lemma usually awned:
6. All spikelets alike:
7. Racemens on a short common axis or cles or racemosely arranged on an elongated common axis:
8. Spikelets all pedicelled ....*Imperata*
8. Spikelets one sessile, the other pedicelled:
9. Panicles narrow, villous to tomentose; glumes coriaceous .... *Narenga*
9. Panicles wide, silky hairy; glumes membranous .... *Saccharum*
7. Racemes on a short common axis or digitate or sometimes solitary:
10. Spikelets 2-flowered .... *Eulaliopsis*
10. Spikelets 1-flowered:
    11. Lower glumes dorsally flattened or shallowly concave between the keels; upper lemma bidentate at the apex .... *Eulalia*
    11. Lower glumes convex on the back; upper lemma stipiform ...*Pseudopogonatherum*
6. Sessile and pedicelled spikelets dissimilar:
    12. Joints and pedicels trigonous, rounded or flat:

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13. Upper lemma awned:

14. Racemes many noded, not enclosed in a spathe like sheath .... *Ischaemum*

14. Racemes 1-noded, partially enclosed into boat-shape, spathe..... *Apluda*

13. Upper lemma not awned:

15. Sessile spikelets globose .... *Hackelochloa*

15. Sessile spikelets not globose:

16. Racemes compressed; spikelets of each pair similar..... *Hemarthria*

16. Racemes cylindrical; spikelets of each pair dissimilar:

17. Pedicelled spikelets distinct and more or less of same size .... *Rottboellia*

17. Spikelets all sessile; pedicelled rudimentary .... *Mnesithea*

12. Joints and pedicels slender, rarely thickened upwards:

18. Racemes in whorled panicles, never spatheate:

19. Lower glumes not flattened on the back:

20. Panicles dense, contracted .... *Pseudosorghum*

20. Panicles lax, open .... *Sorghum*

19. Lower glumes flattened on the back:

21. Spikelets triad, one sessile and two pedicelled .... *Chrysopogon*

21. Spikelets biad, one sessile and other pedicelled .... *Vetiveria*

18. Racemes digitate, subdigitate or in pairs or solitary terminal, usually spatheate:

22. Lemma awned from the back .... *Arthraxon*

22. Lemma awned from the tip or sinus:

23. Margins of lower glumes of sessile spikelets sharply infolded, two keeled, awn glabrous:

24. Lemma awned from the tip:

25. Racemes in compound spatheate panicles .... *Capillipedium*

25. Racemes not in compound spatheate panicles:

26. Lower involucral glumes with pits .... *Bothriochloa*

26. Involucral glumes without pits .... *Dichanthium*

24. Lemma awned from a sinus:

27. Plant aromatic: racemes binnate, supported by spathe arranged in panicles .... *Cymbopogon*

27. Plant not aromatic racemes solitary terminal on the culms and branches .... *Schizachrium*

23. Margins of lower glumes inturned and rounded at the sides; awn usually hairy:

28. Racemes surrounded at the base by an involucre of homogamous, sessile, non-deciduous spikelets .... *Themeda*

28. Racemes without an involucre .... *Heteropogon*

5. Spikelets solitary or paired, more or less similar; glumes usually membranous, at the lower usually smaller or sometimes: suppressed: upper lemma usually awnless:

29. Spikelets in open or contracted panicles:

30. Spikelets in open panicles:

31. Spikelets not supported by bristles:

32. Spikelets gibbous laterally compressed .... *Cyrtococcum*

32. Spikelets not gibbous .... *Panicum*

30. Spikelets in contracted spike like panicles .... *Hymenachne*

29. Spikelets in secundate spiciform racemes or false spikes:

33. Upper lemma crustaceous or coriaceous:

34. Spikelets adaxial:

35. Glumes awned:

36. Blades lanceolate to ovate .... *Oplismenus*

36. Blades linear, narrow .... *Echinochloa*

35. Glumes awnless:

37. Lower glumes well developed:

38. Aquatic plants ....*Paspalidium*

38. Terrestrial or marshy plants .... *Urochloa*

37. Lower glumes absent .... *Paspalum*

34. Spikelets abaxial............*Brachiaria*

33. Upper lemma thinly cartilaginous usually with flat hyaline margin.........*Digitaria*

31. Spikelets supported bristles:

39. Bristles caducous, forming an involucre; upper lemma smooth......*Pennisetum*

39. Bristles persistent, solitary; upper lemma transversely rugose......*Setaria*
2. Spikelets always with a single hermaphrodite floret; if two-flowered, with one of the floret barren, then lemmas as firm as glumes:
    40. Spikelets arranged in open or contracted spikelike panicles:
        41. Spikelets with 2 or more fertile florets:
        42. Glumes shorter than the lowest florets:
            43. Lemmas 5-many nerved......*Poa*
            43. Lemmas 1-3 nerved:
44. Spikelets in open, contracted or spikelike panicle . . . .*Eragrostis*
44. Spikelets in open, contracted or spikelike panicle
    45. Rachis ending in spikelets:
    46. Spikelets falling entire of straight spikes which are numerous and crowded into long narrow dense panicles .... *Desmostachya*
    46. Spikelets breaking up at maturity: spikes few to many..........*Eleusine*
        42. Glumes longer than the lowest florets:
        47. Lemmas and rachila glabrous ....*Avena*
        47. Lemmas and rachila joints with long silky hairs ....*Phragmites*
        41. Spikelets with one fertile floret:
        48. Glumes minute or suppressed: fertile lemma and palea very similar in shape and texture:
        49. Blade ovate-oblong or ovate-lanceolate with inflated sheath .... *Hygroryza*
        49. Blade linear, acute or acuminate .... *Oryza*
        48. Glumes well developed; fertile lemma and palea dissimilar:
        50. Spikelets with 3-florets......*Phalaris*
        50. Spikelets with 1 to 2-florets:
            51. Spikelets with 2-florets .... *Arundinella*
            51. Spikelets with 1-floret:
                52. Lemmas 1 to 3-nerved .... *Perotis*
                52. Lemmas 5-nerved .....*Polypogon*
    40. Spikelets arranged on one side of the tough-rachis:
53. Spikelets awned ....*Chloris*
53. Spikelets awnless ....*Cynodon*
    45. Rachis ending in a sharp point .... *Dactyloctenium*

Species list

1. *Dendrocalamus strictus* (Roxb.) Nees
Occasionally in North Kheri forest division.
K.K.S. 7684. *Local name*—Bans.

2. *Coix lacryma-jobi* Linn.
In moist locations near villages. Rare; Fls. & Frs.: Sept.-December. KKS 4359.

3. *Chionachne koenigii* (Spreng.) Thw.
Common in grasslands.
Fls. & Frs.: August-November.
KKS 4193, 4291, 7524.

4. *Imperata cylindrica* (Linn.) Beauv.
Common in grasslands and in open grounds.
Fls. & Frs.: June-October. KKS 7672, 8420. *Local name*—Bharuee.

5. *Narenga porphyrocoma* (Hance) Bor
Occasionally in open areas and in grasslands.
Fls. & Frs.: October-November. KKS 4294, 7844.

6. *Saccharum spontaenum* Linn.
Common along river banks, in swamps and along the bunds of fields etc.;
Fls. & Frs.: September-January. KKS 3024, 7500.
Local name— Kans.

7. *Saccharum bengalense* Retz.
Frequent in marshes and along railway lines.
Fls. & Frs.: September-October. KKS 4330
Local name—Munj.

8. *Eulaliopsis binata* (Retz.) Hubb.
Occasionally in open dry areas near sal forests.

Fls. & Frs.: October-February. KKS 7618.

9. *Eulalia leschenaultiana* (Decne) Ohwi
Occasional in moist areas.
Fls. & Frs.: September-November. KKS 7879.

10. *Pseudopogonatherum contortum* A. Camus
Frequent in grasslands.
Fls. & Frs.: October-December. KKS 7865.

11. *Ischaemum rugosum* Salib.
Common in marshes and rice fields.
Fls. & Frs.: September-December. KKS 7945, 8423.

12. *Apluda mutica* Linn.
Common in open grasslands and along railway lines.
Fls. & Frs.: September-February. KKS 4188, 7787, 8534.

13. *Hackelochloa granularis* (Linn.) O. Ktze.
Frequent in moist places in sal forest and in grasslands.
Fls. & Frs.: September-December. KKS 7397, 7788, 8520

14. *Hemarthria compressa* (Linn.f.) R. Br.
Common in marshy areas and in rice fields.
Fls. & Frs.: July-September. KKS 8440, 8467.

15. *Rottboellia exaltata* Linn. f.
Frequent along water courses.
Fls. & Frs.: August-November. KKS 7951.

16. *Mnesithea laevis* (Retz.) Kunth
Common in grasslands and in the moist bed of rice fields.
Fls. & Frs.: July-December. KKS 7707.

17. *Pseudosorghum fasciculare* (Roxb.) A. Camus
Common in grasslands and along railway lines.
Fls. & Frs.: September-December. KKS 7876, 7881, 7974.

18. *Sorghum nitidum* (Vahl) Pers.
Common in grasslands and along railway lines.
Fls. & Frs.: September-December. KKS 4179, 4206, 4325.

19. *S. halepense* (Linn.) Pers.
Occasional in cultivated fields and along railway lines.
Fls. & Frs.: September-December. KKS 8533.
Local name—Ghamoy.

20. *Chrysopogon aciculatus* (Retz.) Trin.
Frequent in open wastelands.
Fls. & Frs.: August-November. KKS 2984.

21. *Vetiveria zizanioides* (Linn.) Nash
Common in sal forests and marshy places.
Fls. & Frs.: July-November. KKS 2983, 7550, 7764.
Local names—Seenk, khas .

22. *Arthraxon prionodes* (Steud.) Dandy
Occurs occasionally in open grasslands.
Fls. & Frs.: October-February. G. Saran 26286.

23. *Capillipedium assimile* (Steud.) A. Camus
Occurs commonly along railway lines.
Fls. & Frs.: August-December. KKS 4182, 7979.

24. *Bothriochloa intermedia* (R. Br.) A. Camus
Common in grasslands.
Fls. & Frs.: August-December. KKS 4191, 7686, 7937.

25. *B. pertusa* (Linn.) A. Camus
Common in grasslands and in dried up rice fields, wastelands.
Fls. & Frs.: September-January. KKS 8540; 8551.
Local name—Sandhur.

26. *B. kuntzeana* (Hack.) Hern.
Occasional in open areas and in grasslands
Fls. & Frs.: September-January. KKS 7984.

27. *Dichanthium annulatum* (Forsk.) Stapf
Common in lawns and in wastelands.
Fls. & Frs.: August-January. KKS 7238, 7600, 7619, 8332.

28. *Cymbopogon osmastonii* Parker
Occasional in the north Kheri forest division along forest roads. The grass is endemic to this district.
Fls. & Frs.: September-December. KKS 7877.

29. *C. jwarancusa* (Jones) Schult.
In open areas. Rare.
Fls. & Frs.: August-December. KKS 7181.
Local name—Jarakus.

30. *C. flexuosus* (Nees) Wasts. var. *microstachys* (Hook. f.) Bor
Frequent in grasslands.
Fls. & Frs.: September-December. KKS 4315.

31. *Schizachyrium brevifolium* (Sw.) Nees
Occasional in open areas.
Fls. & Frs.: September-December. KKS 7839.

32. *Themeda arundinacea* (Roxb.) Ridley
Common in low-lying areas in sal forests and grasslands.
Fls. & Frs.: August-December. KKS 4211, 8554.
Local name—Ulla.

33. *Heteropogon contortus* (Linn.) Beauv. ex R. & S.
Common in grasslands and in open wastelands.
Fls. & Frs.: September-December. KKS 4274, 7838.

34. *Cyrtococcum patens* (Linn.) A. Camus
Frequent in low-lying areas and other moist places.
Fls. & Frs.: August-November. KKS 7536.

35. *Panicum austro-asiaticum* Ohwi
Frequent in moist places.
Fls. & Frs.: September-December. KKS 8524.

36. *P. trypheron* Schult.
Frequent in cultivated fields and in grasslands.
Fls. & Frs.: August-December. KKS 7722.

37. *P. paludosum* Roxb.
Common in marshy places, still waters and banks of tanks, ponds throughout the district.
Fls. & Frs.: September-December. KKS 7730, 8473, 8563.

38. *Hymenachne pseudointerrupta* C. Muell
Occasional in marshy areas in South Kheri forest division.
Fls. & Frs.: September-December. KKS 7874.

39. *Oplismenus compositus* (Linn.) Beauv.
Frequently forms a dense, herbaceous, undergrowth in moist, shady areas of orchards.
Fls. & Frs.: August-January. KKS 7822.

40. *O. burmanni* (Retz.) Beauv.
Common in moist shady areas in orchards and in forests.
Fls. & Frs. September-November. KKS 7771, 7821.

41. *Echinochloa stagnina* (Retz.) P. Beauv.
Common in stagnant ditches and banks of ponds etc.
Fls. & Frs.: August-December. KKS 7824, 8501.

42. *E. colonum* (Linn.) Link.
Common in rice fields and other marshy places.
Fls. & Frs.: July-November. KKS 7523, 8417.

43. *E. crus-galli* (Linn.) Beauv.
Common in moist places near ponds, ditches and rice fields of the district.
Fls. & Frs.: August-November. KKS 7761.
Local name—Sawan.

44. *Paspalidium flavidum* (Retz.) A. Camus
Occurs commonly in grasslands and wastelands.
Fls. & Frs.: July-November. KKS 7866, 8424, 8508.

45. *P. punctatum* (Burm. f.) A. Camus
Common in moist places and in rice fields.
Fls. & Frs.: August-December. KKS 8475.

46. *Urochloa panicoides* Beauv.
Common in moist places and in pastures.
Fls. & Frs.: August-November. KKS 8429.

47. *Paspalum distichum* Linn.
Common on moist banks of ponds and ditches.
Fls. & Frs.: June-September. KKS 7417, 8427.

48. *P. commersonii* Lamk.
Occurs occasionally in rice fields.
Fls. & Frs.: September-January. KKS 2988.

49. *Brachiaria reptans* (Linn.) Gard. & Hubb.
Frequent in moist places and in rice fields.
Fls. & Frs.: September-January. KKS 8549.

50. *B. distachya* (Linn.) Stapf
Frequent in grasslands.
Fls. & Frs.: August-December. KKS 8444.

51. *B. ramosa* (Linn.) Stapf
Frequent in moist wastelands.
Fls. & Frs.: July-November. KKS 8418.

52. *B. kurzii* (Hook. f.) A Camus
Occurs occasionally in moist places.
Fls. & Frs.: August-November. KKS 8465.

53. *Digitaria adscendens* (H.B. & K.) Henr.
Frequent in open areas.
Fls. & Frs.: July-November. KKS 8553.

54. *Pennisetum polystachyon* (Linn.) Schult:
Occurs occasionally in grasslands.
Fls. & Frs.: July-November. KKS 7645.

55. *Setaria verticillata* (Linn.) Beauv.
Frequent in moist areas.
Fls. & Frs.: August-November. KKS 3067.

56. *S. glauca* (Linn.) Beauv.
Common in wastelands and in open grasslands.
Fls. & Frs.: August-October. KKS 3029, 7786.

57. *S. tomentosa* (Roxb.) Kunth
Occurs commonly in moist grassland.
Fls. & Frs.: August-December. KKS 7572.

58. *Poa annua* Linn.
Occurs occasionally on moist ground.
Fls. & Frs.: December-February. KKS 7890.

59. *Eragrostis tennella* (Linn.) P. Beauv. ex R. & S.
Occurs commonly in moist places.
Fls. & Frs.: September-February. KKS 4187, 7818, 7845.

60. *E. japonica* (Thunb.) Trin.
Occurs commonly in moist places in wastelands and in grasslands.
Fls. & Frs.: September-February. KKS 4187, 7810, 7845.

61. *E. atrovirens* (Desf.) Trin. ex Steud.
Frequent in grasslands near moist places.
Fls. & Frs.: August-November. KKS 8435, 8476.

62. *E. unioloides* (Retz.) Nees ex Steud.
Occurs commonly in moist shady places.
Fls. & Frs.: September-November. KKS 4214, 4297, 7376.

63. *Desmostachya bipinnata* (Linn.) Stapf
Frequent in grasslands.
Fls. & Frs.: June-November. KKS 2979, 4108, 8552.
Local name—Kusha.

64. *Eleusine indica* (Linn.) Gaertn.
Occurs as a weed in cultivated fields.
Fls. & Frs.: August-November. KKS 8433.

65. *Avena fatua* Linn.
Occurs occasionally in cultivated wheat fields.

Fls. & Frs.: February-April. KKS 7650.
Local name—Jaee.

66. *Phragmites maxima* (Forsk). Blatt. & McC.
Common in marshy places and near streams.
Fls. & Frs.: December-February. KKS 2818, 2997, 4229.
Local name—Narkul.

67. *Hygroriza aristata* (Retz.) Nees & W.&A.
Occurs commonly in lakes and ponds throughout the district.
Fls. & Frs.: October-February. KKS 7454.

68. *Oryza sativa* Linn.
Cultivated throughout the district.
Fls. & Frs.: September-November. KKS 7758.
Local name—Dhan.

69. *O. rufipogon* Griff.
Occurs commonly mixed with paddy in cultivated fields.
Fls. & Frs.: October-November. KKS 7746, 8487.
Local name—Pasaee.

70. *Phalaris minor* Retz.
Frequent as a weed in wheat fields.
Fls. & Frs.: January-April. KKS 7645.
Local name—Senhu.

71. *Arundinella bengalensis* (Spreng.) Druce
Frequent in moist shady places.
Fls. & Frs.: July-October. KKS 8539.

72. *Perotis indica* (Linn.) O. Ktze.
Frequent in open wastelands and shady places.
Fls. & Frs.: August-October. KKS 7432, 7720.

73. *Polypogon monspeliensis* (Linn.) Desf.
Commonly in moist, sandy areas and in sal forests of the district.
Fls. & Frs.: January-March. KKS 2813, 7117, 7243.

74. *Chloris dolichostachya* Lagasca
Frequent in moist shady places.
Fls. & Frs.: August-November. KKS 4151.

75. *C. barbata* (Linn.) Sw.
Occurs commonly in open grasslands in sandy places.
Fls. & Frs.: August-November. KKS 4359.

76. *Cynodon dactylon* (Linn.) Pers.
Occurs commonly in wet and dry location.
Fls. & Frs.: Most part of the year KKS 8381.
Local names—Ghas, Dub.

77. *Dactyloctenium aegypticum* (Linn.) Beauv.
Occurs as a weed in waste sandy areas and cultivated fields.
Fls. & Frs.: June-November. KKS 4386.

ACKNOWLEDGEMENTS

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PREDATORY BEHAVIOUR OF AN ASSASSIN SPIDER, *CHORIZOPES* SP. (ARANEIDAE), AND THE DEFENSIVE BEHAVIOR OF ITS PREY[1]

William G. Eberhard[2]

The araneid spider *Chorizopes* sp. preys on other araneids, using the aggressive response of its prey toward smaller-sized intruders in their webs to lure them to their death. One prey species (*Leucauge* sp.) avoids attacks by cutting free sectors of the web which hold the predator.

INTRODUCTION

Spiders are generally thought of as solitary animals which react aggressively toward others of their own kind, and this seems to be the general rule in orb weaving spiders. Web owners usually respond to the presence of other spiders by shaking the web strongly; if the invader is smaller and does not leave, the owner moves toward it and chases it from the web (e.g. Buskirk 1975, Eberhard *et al.* 1979, Lahmann and Eberhard 1979, pers. obs. of *Alpaida, Cyclosa, Cyrtarachne, Leucauge, Metazygia, Nephilengys, Tetragnatha, Philoponella,* and *Uloborus*). This note describes the behaviour of a rare and previously unstudied spider, *Chorizopes* sp. (Araneidae), which appears to prey regularly on orb weavers by taking advantage of this aggressive response.

It is probably common for spiders to prey on each other (e.g. Bristowe 1958, Turner 1979), but most of this predation probably results from chance encounters involving species which take a large variety of other kinds of prey. There are three spider groups known to be specialized spider predators, however: Mimetidae (e.g. Bristowe 1958), Archaeidae (Kaestner 1968), and some species of the theridiid genus *Argyrodes* (Clyne 1979, Eberhard *in prep.*). This appears to be the first report of regular predation on other spiders by an araneid.

These observations were made in Nov. 1979 during the monsoon at Ayyanar Falls (*c.* 300 m.) 5 km W. of Rajapalayam, Tamilnadu, India. The spiders were moderately common in underbrush in deciduous forest, but were not found in adjoining thorn scrub.

The first indication that *Chorizopes* preyed on web weaving spiders came from finding four individuals (three mature females and one penultimate female) in close association with freshly dead araneids (three mature *Leucauge* sp., and one mature female *Cyrtarachne* sp.). In all cases the *Chorizopes* was substantially smaller than the other spider. Two of them were apparently feeding on the dead spider (mouth in contact with it, other spider somewhat shrivelled). As I watched, a third *Chorizopes* wrapped an apparently freshly dead *Leucauge* with slow alternate movements of legs IV, then slowly transported it along the edge of the *Leucauge* web, using complex behaviour involving fastening it to a frame line, then breaking the frame and letting it sag by letting out silk until the

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prey hung vertically, then raising the prey to attach it to the frame again and repeat the process until the prey was completely off the web and under a leaf. There the spider spun a small mesh sustaining the prey and began to feed. Three times during the transportation process the spider paused, moved to the anterior end of the prey, and pressed its mouth against the prey's mouth for several seconds, perhaps feeding.

I succeeded in confirming this suggestive evidence of predation by witnessing an attack in the following circumstances. I found a mature female *Leucauge* sp. in the midst of web construction 30-60 min. after the end of a rain shower, after all nearby conspecifics had finished their webs. Close inspection of this web showed partially collapsed radii in one sector, and other threads which suggested that an anchor thread on that side of the web had been broken near the end of radius construction, and that the spider had tightened up the damaged sector and continued building. The *Leucauge* was unusually "nervous", running to the edge of the web several times in response to apparently minor stimuli, pausing 30 sec. or more during sticky spiral construction several other times, and laying the sticky spiral in an irregular pattern. The possible reason for the spider's delay, its collapsed web, and its unusual behaviour was revealed when I searched the leaf where the hypothesized broken anchor would have ended, and found an immobile female *Chorizopes*.

When the *Leucauge* finished building, I detached the leaf gently and brought the *Chorizopes* into contact with an anchor line of the *Leucauge* web, which it stepped onto readily. The *Leucauge* immediately turned toward this sector and shook the web strongly, and the *Chorizopes* responded with vigorous shakes of its own. The *Leucauge* then advanced rapidly toward the invader, pausing to shake the web and receive answering shakes on the way. Despite its small size (estimated weight about one fourth that of the *Leucauge*), the *Chorizopes* stood its ground as the other advanced; the spiders met in a very brief tangle of legs, and the *Leucauge* fell free under the web, hung for a moment immobile on its trail line, then climbed back to the hub where it briefly cleaned one front leg in its mouth, then settled into its normal resting position.

For the next six minutes both *Leucauge* and *Chorizopes* remained nearly motionless, but toward the end of this period the *Leucauge* seemed to "sag" slightly, its abdomen tilting downward at the rear and its hind legs extending more than usual. My suspicion that it had been bitten in the brief encounter was confirmed when the *Chorizopes* finally began moving deliberately, first along the frame and then along a radius toward the hub, and the *Leucauge* failed to respond. Its only movement was a weak jerk when the *Chorizopes* touched it lightly with a leg; after the *Chorizopes* waited another minute, it submitted without resistance when it was bitten and then wrapped.

I then attempted to elicit another complete attack sequence by transferring the *Chorizopes* to three other *Leucauge* webs, but instead discovered the defensive behaviour of *Leucauge* sp. In a typical sequence, the *Chorizopes* was on an anchor thread when the owner shook the web aggressively and approached in an apparent attempt to chase it away. Instead of just walking along the anchor toward the invader, however, the *Leucauge* damaged its own web by breaking the line and proceeding by reeling up the broken end and paying out new line behind as it advanced. The defensive significance of this behaviour became clear when the *Leucauge* stopped short of contact with the *Chorizopes* and released the anchor line it had been reeling in; the result was that the orb collapsed on that side, while the *Chorizopes* fell and dangled on the other end of the broken anchor line, all connection to the *Leucauge* web now lost.

DISCUSSION

The repeated observations of *Chorizopes* with dead araneids and its apparently purposeful attack behaviour both suggest that this species commonly preys on web building spiders. The fact that both Simon (1896) and I found it commonly at some sites but could not associate it with any web is in agreement with this idea. The spider's attack behaviour differs from that of other spider specialists in not involving stealthy approaches (some mimetids — Bristowe; *Argyrodes* spp. — Clyne 1979, Eberhard *in prep.*), imitations of its host's courtship behaviour (some mimetids — Kaestner 1968), or quick-acting poison (some mimetids — Bristowe 1958). *Chorizopes* seems to rely instead on superior fighting ability after attracting its victim into range by giving aggressive reactions to web owners' threats. Perhaps the massive chelicerae with long fangs typical of this genus (Simon 1896) are important in these fights. *Chorizopes* may be limited to preying on individuals that are larger enough than itself that they will approach it close enough to be bitten.

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STUDIES ON THE SPAWNING ECOLOGY OF KUMAUN MAHSEER *TOR TOR* (HAMILTON) AND *TOR PUTITORA* (HAMILTON)[1]

S. S. Pathani[2]

(*With a text-figure*)

The spawning ecology of mahseers (*Tor tor* and *Tor putitora*) of Kumaun area was investigated in Bhimtal lake. The spawning grounds of the mahseers in the lake ranged from a depth of 2.00 to 2.50 m in the inshore region, with sandy bottom, pebbles and aquatic weeds where higher temperature and dissolved oxygen prevailed in comparison to other regions of the lake. Spawning season extended from April to September and May to September for *Tor tor* and *T. putitora* respectively. Intermittent breeding (four spawning acts in a season) was recorded. Maturity size and age of both the sexes of the mahseers were also obtained.

INTRODUCTION

Several investigators have studied the problem of spawning ecology in many fishes of commercial importance while a few have recorded preliminary observations on mahseers, *T. tor* and *T. putitora,* such as Beavan (1877); Thomas (1893); Hora (1939, 1940); Khan (1939); Kulkarni (1971); Jhingran and Sehgal (1977) and Pathani (1977). However, the present paper deals extensively with spawning habits, spawning periods, spawning grounds, maturity size, age and egg diameter during breeding season of mahseers in the cold water lake of Bhimtal, Kumaun (U.P.)

MATERIALS AND METHODS

Survey of spawning grounds was carried out with the help of long handled dip nets and gill-nets. The eggs, larvae and fry were collected by similar dip nets. The colour of fertilized eggs of the two species of mahseers was identified by repeated observations. Dissections of various mature and ripe fishes were done during last three years (1975-78) and age of mature fishes was studied with the help of scales, operculum and otoliths.

Physical features of lake Bhimtal:

The lake is situated 22 Km. north-east (24°21′N, 29°34′E) of Nainital, at an altitude of 1350 m. The depth ranges from 1.00 to 26.00 m. The lake has a length of 1670.00 m at its longest and width of 447.00 m at its broadest region. The shallow littoral region ranges from 2.00 to 5.50 m in depth, and it is here, that the spawning grounds of both the mahseers are located. The map (fig. 1) shows the location of spawning grounds and sites (collection spots) of the mahseers in the lake.

OBSERVATIONS

Spawning sites and grounds:

They are located mostly in mallital basin (upper region of the lake area) and certain shore regions of the lake. In mallital basin, where the main spawning grounds are situated the spawning sites in the inshore region were

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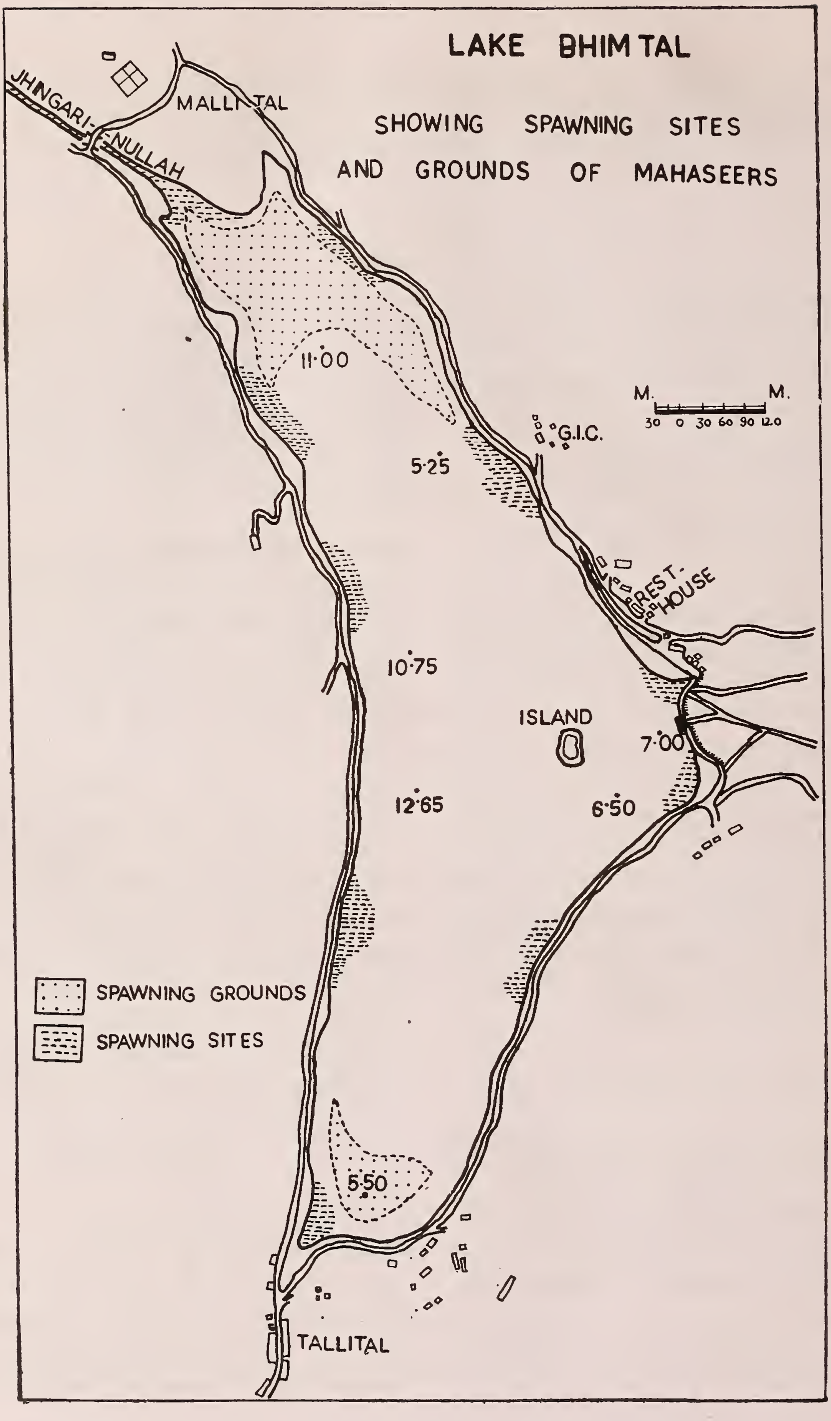
LAKE BHIMTAL
SHOWING SPAWNING SITES AND GROUNDS OF MAHASEERS
JHINGARI-NULLAH
MALLITAL
11·00
M.
M.
30 0 30 60 90 120
G.I.C.
5·25
REST-HOUSE
10·75
ISLAND
7·00
12·65
6·50
SPAWNING GROUNDS
SPAWNING SITES
5·50
TALLITAL

Fig. 1. Map showing the location of spawning grounds and sites (collection spots) of the mahseers in the lake.

observed throughout the study (fig. 1). This spawning ground has a perennial streamlet (Jhingari nullah) which has a higher temperature (23.5°C) than the other regions (21.5°C) of the lake with high dissolved oxygen content (9.5 ppm). The bottom is pebbly with sand and forms a favourable fish-spawning substratum. More Aquatic weeds are present in mallital basin than in other regions of the lake. During the breeding season (April to September), anglers were able to get many male and female mature fishes in the region.

Experimental gill-netting within the range of 2.50 to 5.50 m was done at night during the breeding season, specially in August and September, when many mature and ripe male and female mahseers were caught by me. In other regions (mid-lake and deep regions), mature or ripe fishes were rarely caught. The abundant aquatic weeds of the region were identified as *Ceratophyllum, Myriaphyllum, Hydrilla, Vallisneria, Polygonum, Potamogeton* etc.

Eggs and larvae were collected mainly from 2.00 to 3.50 m. depth by a long handled hand net, indicating that it was the spawning site. However, spawning grounds extended upto 5.50 m. depth in certain places from where eggs and larvae were occasionally collected. Eggs were some times collected, attached to *Hydrilla* leaves; but most of the eggs and larvae of *T. tor* and *T. putitora* were collected free along with sand and pebbles at the bottom. From the same inshore area ripe fishes were caught by large gill-nets during the night, when mahseers come out for spawning, there by confirming that this area was the breeding ground of the fish. In addition to this the spawning of the fish was also seen during mid day and evening.

Spawning habits:

Courtship is a long process, when several males chase the females at breeding sites. Two to seven males are seen chasing a female. When the female found a suitable site the eggs were laid and at the same time the males swam around the female contacting it by making rapid movements of the caudal region after which they fertilized the spawned eggs with their milt. After a short time both males and female returned to the deeper part of the lake, showing no parental care either by male or female. The male and female mahseers could

TABLE I

FOUR INTERSPERSED GROUPS OF OVA (EGGS). a,b,c, AND d IN THE RIPE OVARY ACCORDING TO THEIR DIAMETER IN MAHSEERS

Months	Groups (Ova diameter in mm)				Groups (Ova diameter in mm)			
	Tor tor				*Tor putitora*			
	a	b	c	d	a	b	c	d
April	0.512	0.951	1.40	1.915	—	—	—	—
May	0.512	0.941	1.41	1.975	0.744	1.196	1.609	2.019
June	0.645	0.875	1.42	1.880	—	1.466	1.504	2.501
July	0.720	0.883	1.810	2.427	0.712	1.312	1.706	2.050
August	—	0.930	1.507	0.180	0.825	1.462	1.980	2.866
September	—	1.052	1.527	2.840	—	1.205	1.712	2.410

easily be identified in inshore regions by their sexual differentiating characters (Pathani 1978).

Spawning period and eggs:

Regular dissections of male and female *T. tor* and *T. putitora* showed that the spawning period of *T. tor* extended from April to September and of *T. putitora* from May to September. During ripe condition in both the fishes the female exudes eggs and male oozes milt when slight pressure is applied on the abdomen. These ripe male and female mahseers were also examined by continuous microscopic observations of the gonads for the whole year. After October, in both fishes, the gonads were spent. These observations, on spawning periods of both the species, were also confirmed by the collection of eggs and larvae of *T. putitora* during May to September and during April to September, vide Table II.

TABLE II

DATA OF FERTILIZED EGGS OF MAHSEERS COLLECTED BY HAND (DIP) NET

Months	*Tor tor* No. of eggs/ trial (average)	*Tor tor* Fertilized egg diameter in mm	*Tor putitora* No. of eggs/ trial (average)	*Tor putitora* Fertilized egg diameter in mm
April	10	2.16	—	—
May	8	2.88	25	2.98
June	12	2.76	9	3.02
July	20	2.30	29	2.88
August	11	2.77	26	2.99
September	7	2.23	12	2.92

The fertilized eggs which were collected from spawning sites, were separated for *T. tor* and *T. putitora. Tor tor* has orange coloured and smaller sized fertilized eggs than *T. putitora;* while *T. putitora* has yellow slight orange coloured and larger fertilized eggs. No colour differentiation of larvae of *T. tor* and *T. putitora* could be observed as in the case of fertilized eggs. The d batch of eggs (vide Table I) was always ripe in both the mahseers where the diameter is variable. The reared fry (12 days after hatching in the laboratory) of both *T. tor* and *T. putitora* have acquired characters of their adults with their congenital body relationships to identify separately (Table III). The yolk has completely disappeared. The chromatophores on snout and on head have also disappeared but many chromatophores are scattered on the back of the larvae. The fins are fully formed with 9-10 rays of pectoral fins and 9 rays of anal fin. A spot on caudal peduncle is present.

TABLE III

DISTINGUISHING CHARACTERS OF FRY OF MAHSEERS

	Tor tor	*Tor putitora*
Total length in mm (TL)	14.01	14.30
TL/Length of head	4.83	5.00
TL/Width of body	5.00	6.00

To establish the number of spawning acts the ovarian ova were measured during the breeding period. Ovaries in both *T. tor* and *T. putitora* showed four groups of eggs according to the size present in the ripe ovary. These different sized interspersed eggs (a,b,c, and d; Table I) were present throughout the breeding season. But the group (smallest sized group of eggs seen by naked eye) was absent in the month of August and September in *T. tor* as they had developed further (to b,c, and/or d), indicating four acts of spawning. The eggs of *T. putitora* can also be grouped into four size groups (a,b,c and d; Table I) which were present throughout the spawning season, except in the month of September when breeding season is about to end. Both *T. tor* and *T. putitora* are thus intermittent breeders.

Maturity size and age:

Maturity size and age of both mahseers were obtained. The males matured before the female in both the species. The smallest ripe male of *T. tor* was usually only about 202 mm in total length, i.e. after completion of 2 years, while the smallest mature and ripe female was only 289 mm in total length, i.e. within 3 years of age. In *T. putitora* on the other hand the males matured (ripe) only after 207 mm in total length and 2 years of age; while females only after 309 mm in total length and within or after completion of 3 years.

Discussion

The first preliminary account on spawning habits of mahseer was recorded by Thomas (1893); according to him the fish lays its eggs in batches, and that the pelvic fins and anal fins are used during spawning act by the male fish, which marks out a hollow in gravelly grounds. In Kumaun *T. tor* and *T. putitora* four batches of eggs are laid in one breeding season at the gravelly, sandy spawning sites without hollowing the ground.

Khan (1939) recorded that the mahseer of Punjab waters spawns thrice in a year. The spawning grounds according to him have small stones and pebbles in shallow regions with sand. Smith (1947) reported that mahseer breeds throughout the whole year. But in the present study *tor* and *putitora* mahseers have been found to breed from April to September and May to September respectively. Jhingran and Sehgal (op. cit.) reported deeper sandy and gravelly spawning grounds of mahseers in Himachal Pradesh. Some of the collected fertilized eggs of both the mahseers were hatched and reared up to fry stage to distinguish them.

Kulkarni (op. cit.) recorded breeding season of *T. khudree* from July to August when floods and low temperature prevails but no impact of floods was seen in the spawning of Kumaun mahseers. Desai (1973) observed the breeding season of *T. tor* (Narbada river) from July to March and fish attained first maturity after 360 mm in total length with four batches of eggs in the mature ovary similar to Kumaun mahseers.

Beavan (op. cit.) observed small batches of eggs laid for several months (May to August) by mahseer, while Hora (1940) recorded that the breeding season of *T. tor* extended from August to September based on collection of young specimens. Cordington (1946) reported major and minor breeding season of mahseer. But in the present study, the breeding season extended from April to September for *tor* and May to September for *putitora* mahseers of Kumaun Lakes.

Chaturvedi (1976) reported that the smallest mature male of *T. tor* from Udaipur lake was 254 mm and all males mature after 310 mm in length; while the smallest mature female was 322 mm and all females mature after 390 mm in length within one year of age. But mahseers of Kumaun lakes only mature between two and three years of age at somewhat different lengths. The age determined by Chaturvedi (op. cit.) may be doubtful, as he did not do scale, operculum and other studies. Qasim and Qayyum (1961) have observed that *T. putitora* from Aligarh waters spawned several times over a greater part of the year having batches of eggs at all stages of maturity in the ripe ovary. But in the present study only four batches of interspersed eggs were established which were also recorded by Desai (op. cit.) in Narbada *T. tor*. The sizes of ripe eggs (d batch) were variable; this may be due to condition of fish in the lake, as stated in the case of Russian fishes by Nikolsky (1963). In Kumaun Mahseers all immature eggs (a, b,c) were light cream coloured and not transparent in contrast to different coloured eggs in the ripe ovary of *Tor khudree* as reported by Kulkarni (op. cit.).

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THE GHARIAL (*GAVIALIS GANGETICUS*): A REVIEW[1]

ROMULUS WHITAKER[2] AND D. BASU[3]

(*With six plates and a text-figure*)

Gharial were observed over a period of several years at wild locations and in captivity. Surveys were carried out to study the distribution, status and habitat of the species. The literature on gharial was researched. Gharial are fish eaters, being specialized by head morphology and riverine habitat. Other than fish, frogs were taken by captive animals. Birds and rats were usually refused, though the literature includes mammals and birds, as well as reptiles in the gharial's diet. Basking and swimming are common behaviours. One of the most thoroughly aquatic crocodilians, the adult gharial has weak front legs and does not 'high walk' or stand; locomotion on land is the 'forward slide'.

Adult males with prominent 'gharas' (narial excrescence) are dominant in an apparent social hierarchy with females and immature males. Adults are tolerant of immature animals and are sociable, often basking in groups. Interaction with mugger (*Crocodylus palustris*) was observed.

In India gharial nest in March and April, the dry season; the female lays 20-95 eggs in a hole 50-60 cm deep, dug with the hind feet in a riverside sand or silt bank, one to five metres from the waterline. Courtship was observed in captivity. Gharial rarely vocalize, the most common sound being a low growl when intimidated.

Egg collection, the rearing of some 2000 juveniles and the release of three and four year old in three newly gazetted sanctuaries, were carried out by the GOI/UNDP/FAO project. Captive breeding was successful in India at Nandankanan Zoological Park and is being attempted at the Madras Crocodile Bank Trust.

INTRODUCTION

The gharial or gavial has remained one of the least known crocodilians despite its former commonness, wide distribution, size and accessibility. It was first described by Gmelin (1788). Adams (1867) expounded on the abundance and gregarious nature of *Gavialis* in north India. Francis (1910), Lowis (1915) and Rao (1933) remarked on their abundance on the Indus River, Pakistan. I.A.K. (1921) recorded "plenty" of gharial in the Gandak River, Nepal and Shortt (1921) recorded that parts of the Kosi River in Bihar were "teeming" with them.

Anderson (1875) gave the first description of a nest, eggs and young. Hornaday (1885) described the gharial's basking habits, vocalization and the 'ghara' or narial excrescence and proposed early April as the laying period.

Several notes appeared, mainly in this *Journal* in the first 65 years of this century mentioning gastroliths, unusual stomach contents and exceptionally large specimens. Biswas (1970) reported its extremely depleted status

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in some areas; Whitaker *et al.* (1974, 1976) and Bustard (1974) gave further evidence of its rarity.

Gavialis gangeticus is the sole surviving member of a once well-represented family (see Fossil history). It is both taxonomically as well as structurally unique, having the most attenuated snout of all crocodilians.

It is light to dark olive dorsally, with dark cross bands (more prominent in young animals) and a white or yellowish underside. The snout is 3.3 to 5.5 (in young) times the basal width; the individually socketed long thin teeth are arranged thus: $\frac{5+23-24}{25-26}$. Scales are arranged in uniform longitudinal rows with a pair of post-occipitals and nuchals consisting of four transverse rows of 2 scales, continuous with the dorsal scales. There are 21-22 transverse rows of dorsals (6 scales wide), 18-20 double crested caudal scales, 21-24 single crested caudal scales and 30-31 transverse rows of ventrals (Wermuth 1953, Braziatis 1973, Singh & Bustard 1976).

The future of the gharial appears to be secure with the formation of several protected habitats and the successes of State rehabilitation projects in India. Four research scholars have been studying the species for the past several years .

Materials and methods

We have been involved in the survey, study and captive rearing of gharial in India for several years. Most major habitats in India, Nepal and Bhutan were surveyed using both day and night censuses, behavioural observations on wild and captive groups were made, and young (from wild collected eggs) and wild caught adults were reared since 1973. At the Madras Crocodile Bank (MCB) two adults and four juveniles are being reared in a large, landscaped enclosure for captive breeding. Basu carried out egg collection annually for six years in Uttar Pradesh (Girwa River) and Rajasthan (Chambal River).

The literature on gharial was surveyed and is reviewed here to provide a current, but yet incomplete, summary of the species' biology.

Results and Discussion

Fossil history: Members of the family Gavialidae have been found in Tertiary deposits in Asia, North and South America and Europe. Five Pliocene species were found in the Siwalik and Narmada Hills in India, one almost indistinguishable from *Gavialis gangeticus* (Smith, 1935). Hecht (1972) discussed the differences between the Oligocene, Pliocene and Miocene gharial of Colombia, Venezuela and Florida and the tomistomine crocodilians.

Distribution and status in the wild: The range of the gharial includes the river systems of the Indus (in present day Pakistan), the Ganges (India, Bangladesh, with tributaries in Nepal), the Brahmaputra (with one tributary, the Manas River, in Bhutan) and the Mahanandi in Orissa. The single record for the Maingtha stream of the Irrawadi in Burma (Barton 1927) has not been supported by further specimens. Aung Moe (pers. comm.) reiterates the unlikelihood of this species occurring in Burma. Bustard and Choudhury (in litt.) report that the gharial may have occurred on the upper reaches of the Godavari River in recent times.

Old references indicate the gharial's abundance in the past: Indus River in Pakistan (Francis 1910, Rao 1933); Gandak River in Nepal (I.A.K. 1921); Jumna River in Uttar Pradesh (Hornaday 1885), Kosi River in

Bihar (Shortt 1921). Several authors mention seeing groups basking together and in one area on the Jumna River, 22 were counted in two hours (Hornaday 1885).

Population size and status: Due to the combined effects of shooting, nesting, hooking for skin and meat and loss of habitat from river alteration and human settlement, the gharial dwindled to a trace of its former abundance by the end of the 1960's (Biswas 1970, Whitaker *et al.* 1974). By the mid 1970's the largest known wild concentration was 34 animals including adults and juveniles in 5-6 kms of river at Katerniaghat, Uttar Pradesh. Two other relatively substantial breeding populations were located on: a) the Chambal River (Rajasthan, Madhya Pradesh and Uttar Pradesh) consisting of perhaps 50 adults and 100 smaller animals in 600 kms of river; b) the Rapti-Narayani Rivers in Chitawan National Park, Nepal, where 14 adults were recorded (B. Wright, pers. comm.).

Gharial seem to be nearly extinct in Bangladesh (R. Khan 1979), Bhutan (Bustard 1979) and nearly so in Pakistan (Minton, pers. comm.). The total wild populations was estimated as being under 200 (Whitaker & Daniel 1978). As a result of captive rearing and release there are currently about 500 gharial in India now, in the wild. Another 1800 are in captivity.

Habitat: Annandale (1912 in Biswas, 1970) remarks that its distribution corresponds to that of *Trionyx gangeticus* and *Platanista gangeticus*, and literature emphasizes its preference for deep fast flowing rivers. It has even been surmised that one of the reasons for the lack of success in captive breeding has been the failure to provide flowing water for the potential breeders. However, adult gharial are not totally restricted to mainstreams; they have been observed in still water branches of rivers and an adult was even seen in a jheel (lake) surrounded by sand hills ("Sind" 1922). Rao (1933) writes of a sudden increase in gharial on the upper Indus and reports seeing them in open water in the jungle as well as on the main river and ributaries. However, these seem to be exceptions and the prime habitat of the gharial is deep rivers. These include the northern tributaries of the Ganges (up to 300 m above MSL) which drain from the glaciers and melting snow of the Himalayas such as the Girwa, Gandak and Kosi; the rain fed tributaries such as the Chambal, Ken and Son; the Brahmaputra with tributaries both from the Himalayas (north) as well as the smaller hill ranges (south); and finally the Mahanadi in Orissa, far south of the rest of the gharial's range.

Adult gharial show a preference for the comparatively velocity free state found in the deep "kunds" or holes at river bends and confluences. Smaller animals seem to conserve energy by resting out of the main stream in sheltered backwaters, particularly during the monsoon (July-September) when water velocities may multiply by a factor of 5.

For most of the year the Ramganga River in Corbett National Park cannot be called a deep, fast flowing river; gharial are concentrated at the deep pools at sharp bends and this distribution may be characteristic of past habitat preference. The occurence of gharial in some of these larger hill streams, though perhaps not prime habitat, indicates how little undisturbed area remains where the species can survive.

Although there is one report of nesting in a mud bank (Bustard 1980), gharial usually use the steeper sand banks for nesting. Sand and rock outcrops are preferred basking sites and deep water at river bends and junctions a usual feature of confirmed gharial habitat. The relationship and evolutionary significance of habitat to the habit of depositing eggs in a hole (hole nesting) has been suggested in other crocodilians (Carr 1963, Greer 1970). Bustard (1974) notes that while habitat loss is a serious threat to the gharial's existence, gharial have adapted to some degree; nesting in nullahs (side creeks of main rivers) is the main adaptation.

In contrast to the adult and subadult habitats, young during the first year seem to favour hiding in vegetation or debris, often roots or fallen tree branches in the water (Singh 1976). In mid August, 1978, a 57 cm gharial was caught by a farmer in a water logged lowland (Srivastava 1978). It is suggested that in the past when gharial were numerous the young often frequented shallow water and densely vegetated flooded areas away from the main rivers.

Size: Hornaday (1885) judged large gharial he observed to be over 5.40 m long and mentions a stuffed specimen at Allahabad Museum of 5.10 m and another at Jardin des Plantes, Paris, of 6.18 m. Pitman (1925) gives 6.45 m as the maximum length, Bustard (1974) estimates that gharial reach over 8 m and that 6-7 m animals were once common. Two adult males at Satkosia Gorge in Orissa are estimated by Bustard (in litt.) to be 6.6 m long. Shortt (1921) felt that 4.20 m is the upper limit for females and well over 5.70 m for males. Anderson (1875) gives the length of gharial hatchlings as 395 mm. Recently average lengths have varied from 325-374 mm and average weights have ranged from 75-97 gm (Biswas 1970, Singh 1976, 1979). The wild juvenile captured near Katerniaghat, Uttar Pradesh and considered to be a yearling, was 75 cm in length and weighed 550 gm (Srivastava 1978); however, its age was not known. Average lengths and weights of hatchlings from 6 nests are given in Table 1. Average hatchling sizes of Girwa River (Uttar Pradesh) gharial have been found to be significantly smaller than those from the Chambal River (Rajasthan) population.

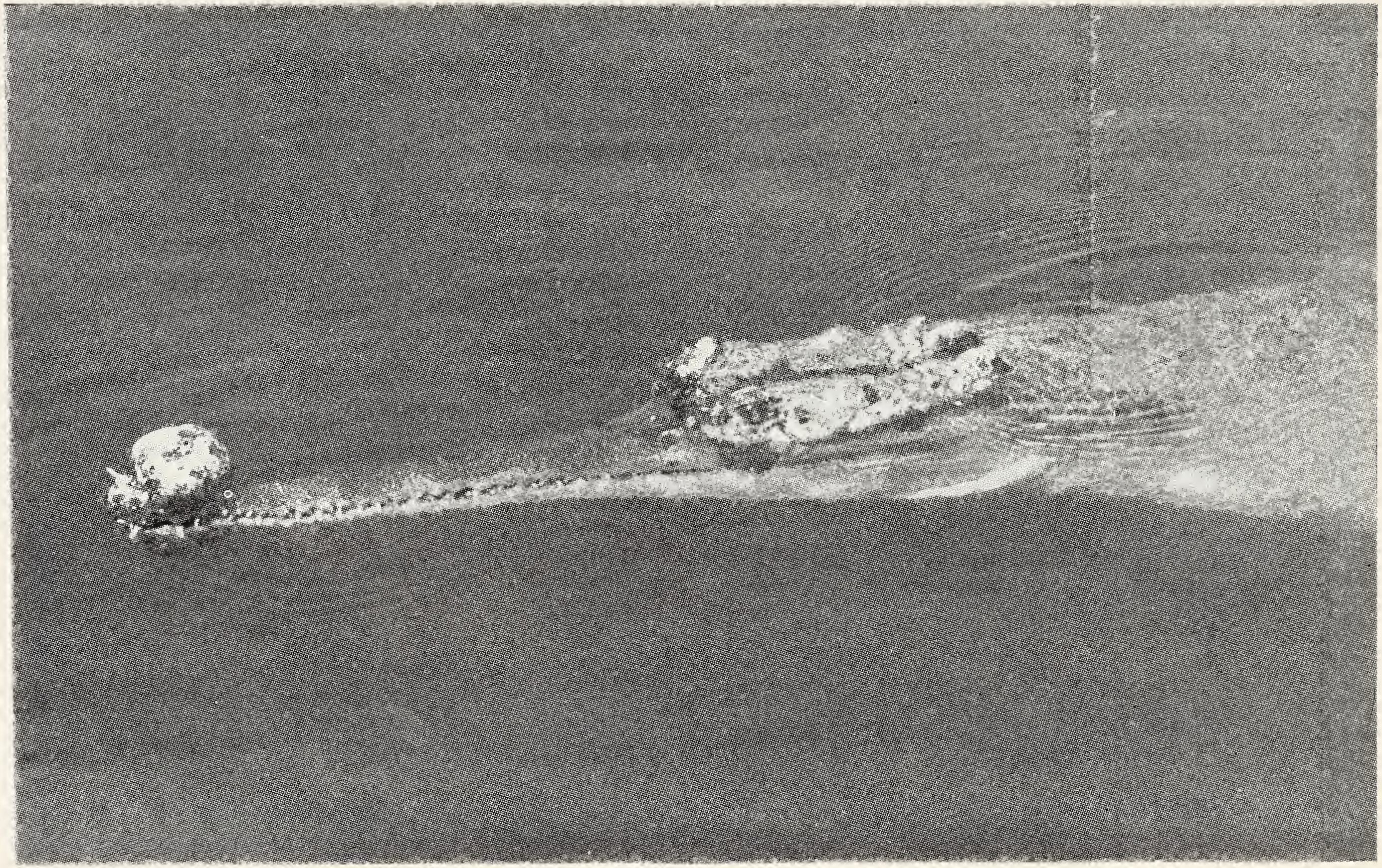
Growth rates: A UNDP news release of late 1977 states that the 1409 juvenile gharial being reared in state projects reach an average length of 1.02 m in 18 months. Singh (1979) reports they reach 1 m in 12-18 months. A 2.7 m male gharial at the Madras Crocodile Bank was 18 years old, and a female of 2.4 m estimated to be over 20 years old (Whitaker *et al.* 1979). Choudhury (1979) gives the following average growth rates for gharial released in Uttar Pradesh in 1979.

No.	Age	Total length	Weight
5	3 yrs, 9 mo.	193 cm	22.5 kg
9	2 yrs, 9 mo.	140 cm	5.28 kg
15	2 yrs, 9 mo.	167 cm	13.6 kg

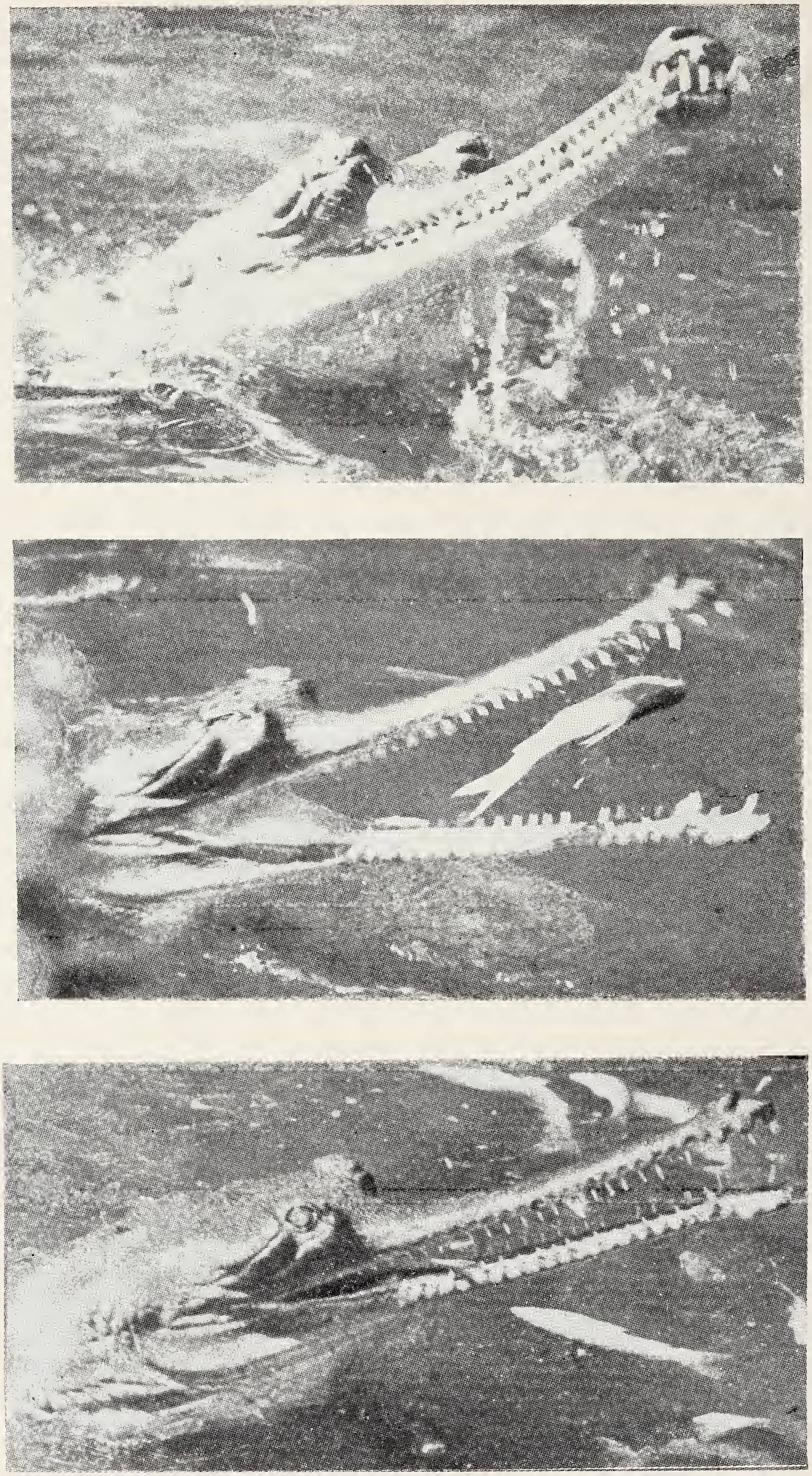
Biswas (1977) gives growth figures for a captive reared male gharial at Nandankanan Biological Park, Orissa. At 1 year, 8 months and length was 135 cm; at 11 years, 6 months the length was 250 cm and at 15 years, 7 months the length was 270 cm. Table 2 gives the average measurements of 588 juvenile from 6 months to 5 years of age.

Longevity: The only longevity record in the literature is from a female at the London Zoo which died in 1972, at the age of about 29 years; its total length was 3.43 m (Guggisberg 1972, Martin and Bellairs 1977). Fishermen who live in the past geographic range of the gharial commonly stated the 'age of man' and 'over 100 years' as being the age attained by a gharial. Certainly their late maturity and large size suggest a long life span.

Sexual maturity: In cloacal probing of 20 gharial from 1 to 3 m, Whitaker *et al.* (1979) point out the difficulties of sex differentiation in animals under 2 m in length. A 2.7 m male,



Adult male gharial with prominent ghara.
(Photo: *Rajesh Bedi*)



This sequence illustrates a gharial positioning a fish by tossing and then swallowing it.
(Photo: *Rajesh Bedi*)

18 years of age had a penis only a few cm. long. Clitoral and penal tips appear identical in sub-adults. We feel that the rate of sexual development is considerably slower than in other crocodilians.

Hornaday (1885) records that the smallest female he shot which contained developing eggs (15) was 2.70 m. A 2.97 m female shot on the Sutlej River contained 56 eggs (Parshad 1914). From these data, the minimum breeding size of a female gharial would appear to be approximately 2.6 m. Males appear to usually reach maturity at a length of over 3 m and an age of 13 to 14 years (Biswas 1977).

Geoffrey-Saint-Hilaire (1925) stated that the narial excrescence or 'ghara' of the gharial is a development peculiar to adult males. It is generally considered to be a sex character of very large animals. Hornaday (1885) found no trace of a ghara in 26 specimens up to 3.6 m in length; the only ones he saw were on 'monsters' of 5-6 m. Large males with gharas are traditionally recognized as the adult males and are given special names (see Table 3) (Whitaker *et al.* 1974; Singh in Martin and Bellairs 1977). Biswas (1977) outlines the development of the ghara of a captive male. It first appeared at an age of 11 years 6 months and at 2.7 m (15 years 7 months) the male had a well developed ghara with the following measurements: length — 5 cm; anterior width — 4 cm; posterior width — 6 cm; height — 3.5 cm. Bustard (in Bellairs 1977 and pers. comm.) sexed this male by cloacal probing and confirmed that it appeared to be mature.

Hornaday (1885) thought the ghara was composed of bone and Neill (1971) discredits its existence. Biswas *et al.* (1977) note that the ghara grows over the nostrils and that the hissing of the surfacing male is caused by this blockage. Earlier, Champion (1934) notes that gharial hiss 'like escaping steam'. The whistle-like exhalation was clearly heard at a distance of 75 m across the Chambal River.

Martin and Bellairs (1977), in their timely treatment of the unique but little known characteristic, give an account of its morphology. They propose three possible functions of the hollow, cartiligenous ghara: as a resonator, as a visual sex recognition character, or in bubbling, spouting or other sexual behaviour. Records of vocalization in gharial are scanty (see 'vocalization'); furthermore there are very few adult males either in captivity or observable in the wild. The function of the ghara must be of important enough evolutionary significance to remain a trait of the species for so long and to offset its disadvantage in creating friction while snapping at fish.

The 3.43 m female at the London Zoo has a partially developed ghara about 3 cm high and 5.4 cm across the base; Martin and Bellairs suggest the animal was abnormal.

HABITS

Prey capture and food: The strongly attenuated snout and rows of uniform sharp teeth are reminiscent of other well known fish eating taxa such as the bottlenose dolphin (*Tursiops* sp.), gangetic dolphin (*Platanista gangeticus*), garfish (*Lepisosteus* sp.) and needlefish (Belonidae). The thin snout meets considerably less resistance when snapping at fish underwater than does that of a mugger for example. Supported by a relatively long, well muscled neck it is a most efficient fish catcher.

Bustard (in Bellairs 1977) says that the gharial is probably the most predominantly fish eating of all extant crocodilians. Singh (1977) points out the distinctive adaptation of the snout and teeth to fish eating. He describes and illustrates the method used by juvenile gharial to manoeuvre fish back to the opening of the gullet by jerking the head back to the side; the fish usually slides in head first. The greater weight of the fish's head allows for this, the most efficient position for swallowing. Singh also describes the habit of small gharial which may run out of the water with fish, particularly large active fish which are likely to escape. Gharial also tear their prey apart by the head jerk technique used by other crocodilians. Whitaker (1975) gives a series of photographs showing the typical swallowing procedure. Neill (1971) describes feeding in juvenile gharial. The sideways snap at fish involves the head and neck only.

Singh (1976) remarks that juvenile gharial feeding on tadpoles and fish seem to rely more on tactile reception than on sight for catching prey. This is certainly the case with a gharial born blind at Satkoshia Gorge (Singh, pers. comm.). An adult female at MCB which is blind in one eye will catch thrown fish with equal success on both sides. The 2.8 m male gharial at Nandankanan watched an attendant throw a live 1-2 kg murrel fish, submerged and had the fish at the surface of the almost opaque water within a few minutes. One specimen caught a peacock which flew into its pen but did not swallow it (Acharjyo, pers. comm.) Juvenile and adult gharial at MCB has been observed feeding on frogs and catching free living *Tilapia* in their large pond. Rats thrown to them were often snapped at, occasionally 'chewed' and held for some time but never swallowed. While captive juvenile and sub-adult gharial are fairly heavy feeders, larger captive specimens subsist on proportionately less feed.

S. Choudhury (in litt.) estimated that captive reared juvenile gharial consumed between 1 and 5% of their body weight in fish daily and that the rate of consumption was temperature related.

Stomach contents: The larger the gharial grows the shorter and heavier set is the snout in relation to its body length (Martin and Bellairs 1977). Large gharial over 15 ft have fairly massive, strong jaws and a large gullet; one can easily imagine their dealing with large strong prey or large items of carrion. Shortt (1921) records that gharial feed on turtles in addition to fish; Biswas (1970) records *Trionyx gangeticus*, the gangetic softshell turtle, as a gharial prey item. Forsyth (1910) records bird remains and weeds in the stomach of a 4.8 m male gharial on the Sarda River. "Sind" (1921) reports that a gharial caught a wild cat (*Felis chaus*). Pitman (1925) reports but doubts a correspondent's claim of finding the hindquarters of a donkey in the stomach of a 6.45 m gharial on the Ghara River.

Hornaday (1885) gives the stomach contents of one 3.3 m female as 3 half digested fish; another 3 m female killed the same day contained only a few bits of a clay pot; others contained only fish remains. It must be kept in mind that fish are soft bodied and quickly digested. Contrary to the standard conception of crocodilians as voracious reptiles with great appetites, Cott (1961) and others have reported and remarked upon the high percentage of empty stomachs encountered in large samples of Nile crocodiles.

Hornaday (1885) unequivocably states that gharial cannot be man-eaters judging from the way his men plunged into the river knowing they were there. A fisherman interviewed on the Brahmaputra in Assam alleged that "many years ago" a seven year old boy was caught and drowned by a large male gharial as the boy was hunting prawns in the shallows. Dodsworth (1910) apparently examined a large number of gharial stomachs and remarked on the number of gastroliths found. Large specimens had empty stomachs except for stones. Shortt (1921) and Biswas (1970) report that ornaments are sometimes found in gharial stomachs. Smith (1931) notes that they will feed on corpses, the probable source of the ornaments. Martin and Bellairs (1977) record human leg bones taken from the stomach of a 4.83 m specimen killed in 1897. Neill (1971) suggests that ornaments might be picked up by gharial on the river bottom as gastroliths. It is true that hard objects other than stones are picked up and swallowed by crocodilians. Forsyth (1910) records finding 4.5 kg of stones in the stomach of a 4.8 m male, the three largest about 225 gms each. He raises the question of whether the stones aid digestion. In 1921 Shortt wrote, "there is always a collection of stones, sometimes quite large, to aid digestion I suppose." Gastroliths remain a subject of considerable debate in spite of Cott's hypothesis on the hydrostatic function of gastroliths (in Nile crocodiles).

Predation:

Basu (1980) reports rats tunnelling into two of the 13 nests located on the Chambal in 1979, resulting in loss of 50% of the eggs. The loss of 33 eggs to rats represents about 7% of the total of almost 500 eggs collected from the 13 nests. Between 1976 and 1980 nine attempts of nest robbing by jackals were recorded at the Chambal River of which seven were unsuccessful, for a predation rate of 5.9% for the 34 nests observed (Basu, unpub. obs.).

Female gharial chased away jackals on three occasions, once after about 14 eggs had been eaten. Several predators on other crocodilians found in gharial habitat are potential predators on the eggs and young. These include wild pig, jackals, common, desert and yellow monitor lizards, domestic dogs, large wading birds and birds of prey. Cannibalism has not been noted in gharial. Tolerance for young animals by adults is noted by Hornaday (1885) in the wild and in captivity at MCB and Mysore Zoo. Thirty eight young from a clutch of 46 were seen with an adult 40 days after hatching, indicating that maternal protection is an important deterrent to potential predators.

Moidart (1895) reports a turtle killing a small gharial in Rajputana, probably in the Chambal River. Indeed the genera *Trionyx* and *Chitra* are among the largest freshwater turtles in the world. These plus fish like *Bagarius* will no doubt prey on small gharial. The most consistently reported predator on large gharial is man. Most of the references on gharial in this *Journal* refer to the killing of one or many gharial. Aside from factors such as habitat loss, the almost total demise of the species has been due to hunting for skin and meat and human predation on the eggs for eating (Whitaker 1974, Bustard 1974).

Amphibious behaviour:

Basu and separately Dodwell in Whitaker *et al.* (1974) remark on the gharial's habit of returning to the same spot every day for basking, which makes them very vulnerable to predation. Singh and Bustard (1977) report that captive juvenile gharial at Satkoshia in Orissa bask for longer periods than do mugger. They typically bask for a few hours after sunrise and sometimes at other times of day. They basked daily in winter and very little in summer.

Whitaker *et al.* (1979) observed two gharial sporadically during April 1974 and report daily basking, mainly in the morning hours until noon. By 18th April increasing temperatures were apparently responsible for the shift in trend from basking on the rocky shelves to basking on sand banks in the shallows. High temperatures and a sharp breeze seemed to discourage afternoon basking.

Hornaday (1885) was impressed by the amount of time during the day the gharial spent basking. He attributes this to the coldness and swiftness of water in their typical habitat. Shortt (1921) accurately outlined the basking pattern. In the cold season (Dec.-Feb.) gharial emerge after 9 a.m. and return to the water at 4 p.m. As the hot weather advances toward its peak in June, they come out earlier in the morning and then later in the evening, returning to the water between 10 a.m. and 5 p.m. He reports that very large animals occasionally bask at night during the hot weather.

Gaping:

As reported for most other crocodilians, gaping is a common habit of basking gharial. A discussion of its possible significance in thermoregulation is beyond the scope of this paper. Ross (unpublished, 1975) writing about the Corbett Park animals, suggests that the frequent display of the yellowish interior of the gharial's mouth while basking was actually a threat display directed at mugger basking nearby. Whitaker *et al.* (1979) report that typical gaping in gharial at Corbett was for 10-20 minute periods with head raised about 20°. At MCB gaping is a regular feature of basking at all times of the year. In summer months (at the peak of the hot season) juvenile and adult gharial would rarely leave the water during the day but hold their heads out of the water at 20-30° angles, gaping, while keeping the rest of the body submerged. This was generally observed in the evening about an hour before sunset and seems to support the 'cleaning hypothesis', i.e. that the crocodilian thus rids its mouth of algae and parasites.

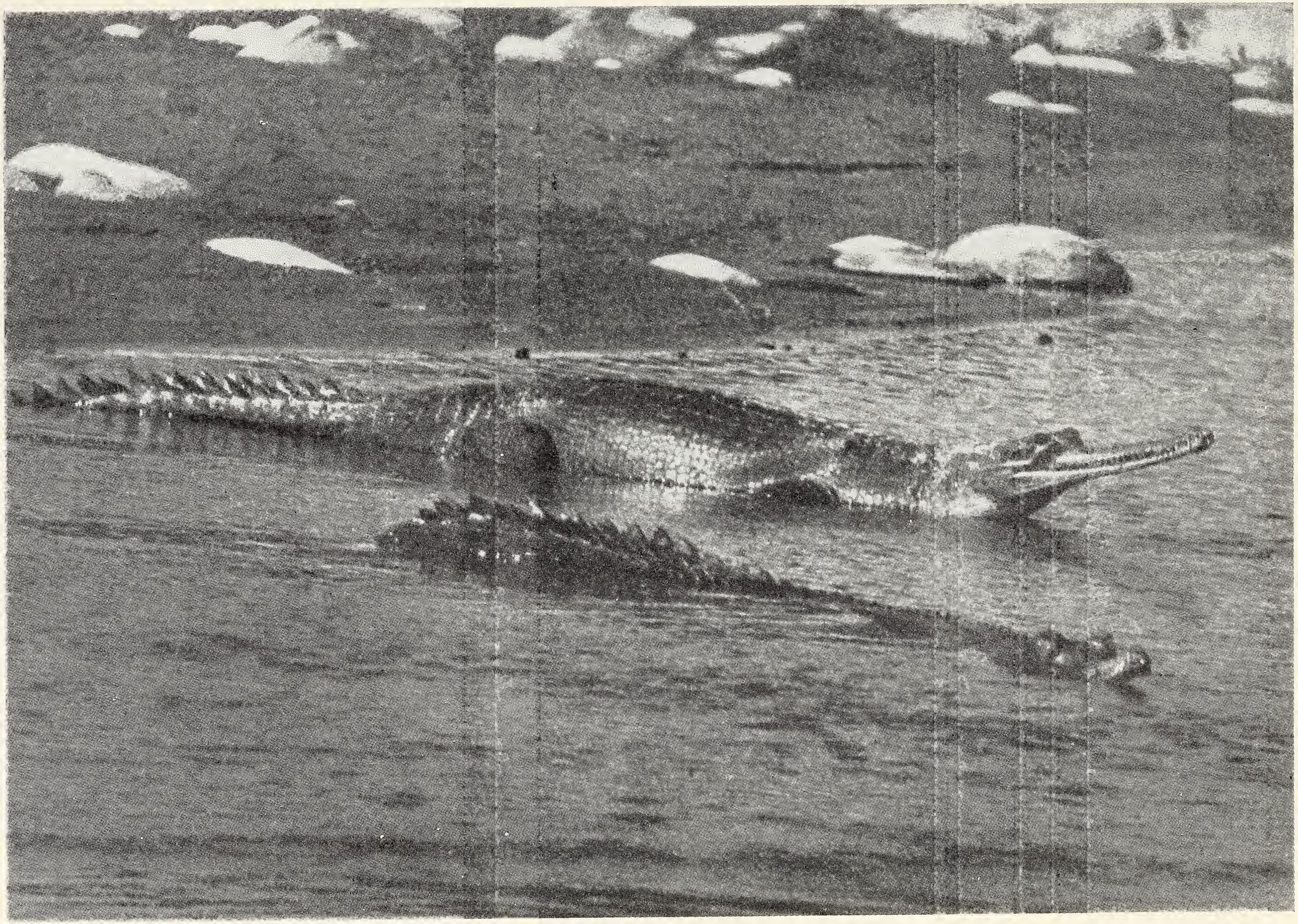
Swimming:

The heavily muscled tail, well webbed hind feet and elongated smooth body are all adaptations for an aquatic existence. Gharial swim with limbs folded against the body except when using them for stability and the 'back dive'. Whitaker *et al.* (1979) observed gharial 'walking' on the bottom of the clear Ramganga River and reported a sinuous bending of the body reminiscent of the varanid gait.

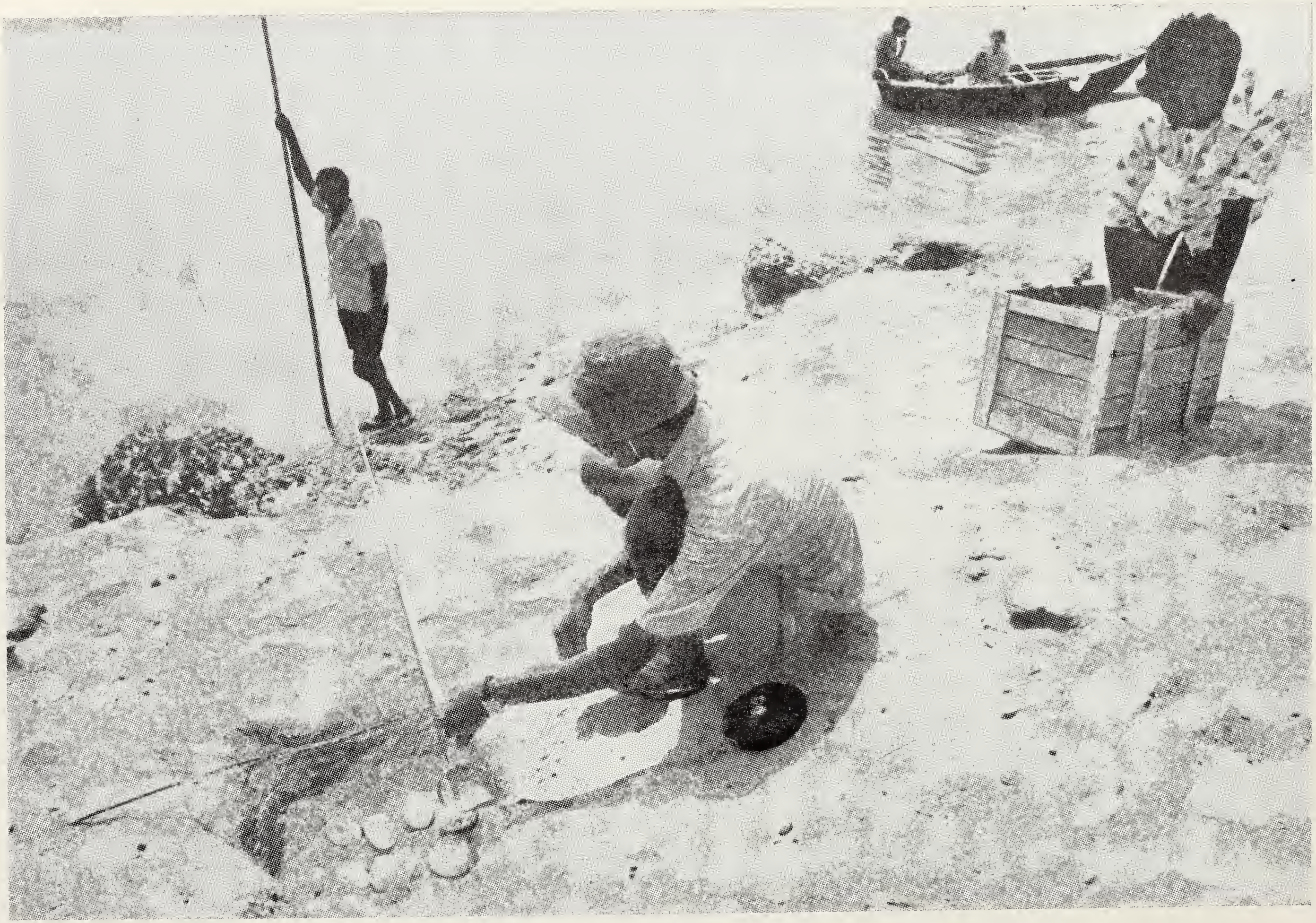
Terrestrial locomotion:

Hornaday (1885) was the first to describe the 'lazy' sliding gait of the gharial on land. Singh and Bustard (1976) report the three gaits described by Cott (1961) for Nile crocodiles (high walk, belly run, gallop) in gharial up to ten months of age. Bustard and Singh (1977) describe the gait of larger gharial as a 'forward slide', pushing with all four limbs in a gait the authors describe as similar to that of a green sea turtle on land. They point out that gharial rarely move far from the water's edge. When they haul out for basking they generally make a 'U' turn near the edge of the water. This locomotion (due to feebly developed front feet), the authors point out, greatly restricts terrestrial movement and could be a primitive mode derived from this oldest living family of crocodilians. The fact that gharial live in deep flowing rivers which do not dry up and that they only need to leave the water for basking and nesting favours the diminishment or nondevelopment of more effective powers of terrestrial locomotion.

Whitaker (1978) described a 2.8 m captive male gharial at MCB which climbed over a 1 m brick wall and used the forward slide rather than a 'high walk' gait to travel a



Wild gharial on the Girwa River, Uttar Pradesh.
(Photo: *Rajesh Bedi*)



Egg collection at a gharial nest site on the Chambal River, Rajasthan.
(Photo: *Rajesh Bedi*)

nocturnal circuitous route of 650 m around the other enclosures before coming back to its own enclosure. Overland migration by gharial is not likely to occur but in case of necessity (accidental isolation in a dry area) short distances can be negotiated by smaller animals.

Homing/migration/dispersal:

Singh (1977) describes a 1.5 m gharial caught on the Mahanadi River and released 15 km downriver, which returned to its original place of capture. Singh (1976) mentioned the extreme sensitivity of hatchling gharial to a change in the arrangement of the *Salix* weeds in their ponds. Alterations in the weed arrangement caused them to leave the water.

Rao (1933) notes the northward migration of large numbers of gharial on the Indus River (Pakistan) and attributes their continued presence on the upper Indus to the closure of a (then) newly constructed barrage. He states that they generally go upstream with the rising water at monsoon time and downstream when the river goes down in the fall and winter. Biswas (1970) reports that gharial are said to move downriver from the Kosi in Bihar to the Ganges during flood time (monsoon). Gharial at Katerniaghat are observed to migrate locally (8-10 kms) every year, always orienting themselves upstream at the flood water period in the monsoon. Adult migration is always very local and seems to be merely to maintain the home range. Juvenile migration (dispersal) is predictably longer and one released specimen travelled over 150 km downstream in a few months (Basu, unpub. obs.).

The return of the female to the nest site as reported by Singh and Bustard (1977), Bustard (1980) and Basu (1980) demonstrates the homing instinct as does the often reported propensity of gharial to return to the same spot to bask.

Bustard (1974) estimates that the 34 young he observed with a large female were a month old, indicating that young stay with the female for at least a month. Maternal attendance may last for at least a year as it does in the mugger (Whitaker, unpub. obs.). It is likely that in undisturbed conditions gharial display protective behaviour for several months or longer. Bustard (1979) and Choudhury (1979) give data on dispersal of captive reared gharial. Table 4 gives the average dispersal distances for animals released in April, 1979.

SOCIAL ORGANIZATION AND REPRODUCTION

Interaction with mugger:

Several of the older references refer to groups of mugger and gharial living in close proximity. Champion (1934) writes that he could count up to 45 of both species in a day on the Mohan River in Uttar Pradesh. He records watching a 3 m gharial chase a similar size mugger from a favoured basking spot. This is contrary to the observations by us and of others who have observed mugger as the dominant aggressors. Whitaker *et al.* (1979) observed interspecific aggression at the Gharial crocodile pool in Corbett National Park. One mugger nested on the same midriver island in the Chambal River as 3 to 5 gharial during 1976-1980. The mugger nest site was separated from the others by its rocky aspect (Basu, unpub. obs.).

Territoriality/Sociality:

In general it was observed that interspecific aggression is analogous to intraspecific territorialism, with size being the most important determinant of dominance. The impression gained in interviewing persons familiar with the species when it was abundant is that the 'harem' group consisted of a large 'knobbed' male with several females. There are numerous references to the gharial's preference for the same basking spot but nothing is known of the degree to which territoriality manifests itself. Basu (1980) writes of a sand bar and nearby rocks which were the regular basking places of 4 adult males (though never together) and 6 females. At Mysore Zoo a 1 m juvenile was often seen basking on the back of one of the 3 m to 3.5 m adults. At MCB adults and juveniles have been housed together for several years with almost no agonistic interaction. At Nandankanan Zoo, Orissa a newly introduced adult male killed the smaller resident male in the breeding enclosure, indicating a territoriality similar to that seen in other adult male crocodilians.

Vocalization:

Champion (1934) writes that a 3 m gharial 'bellowed hard' a number of times, apparently to intimidate a mugger which had usurped its basking spot. Although vocalization has never been reported in association with breeding, gharial certainly have the capacity for making sound in distress situations. Hornaday (1885) wrote that a 3 m animal which had been shot 'groaned three or four times like a strong man in distress'. This groaning sound has been heard several times at MCB from animals of 1.5 m to 2.7 m when closely approached. It often preceded a sudden rush for the water. Choruses of groans were heard in groups of juveniles at the Kukrail Gharial Rehabilitation Centre. Hornaday goes on to say that wounded gharial would often 'bawl aloud like calves when seized', a sound evidently similar to the distress cry of a large mugger when caught. One of his shot animals (3.45 m female) 'bawled' more than a dozen times while struggling. Similarly Basu (974) reports that fishermen say that when caught on hooks buried at basking sites gharial emit loud roars. Rajesh Bedi (in Basu 1980) heard the 'noisy grunt' of a gharial at night as it approached what was presumably its nest.

Courtship and mating:

Mating is in December-January, winter months with low water levels and low temperatures. The near adult male gharial at MCB was observed to jaw slap on two occasions at breeding time. On both occasions the behaviour consisted of three open mouthed slaps on the water surface in quick succession. Compared to the powerful signal in some crocodiles and the American alligator, the gharial's jaw slap is feeble. The jaw slap was followed by a hissing exhalation from the nostrils. One occasion the sun was behind the animal and a cloud of droplets rose to about a meter over its head while hissing. According to Martin and Bellairs (1977), the ghara on the male's snout (Fig. 1) may be an important component of breeding, functioning as a vocal resonator. Considering the weakness of the jaw slap, it certainly seems that vocalization would be the more effective signal. No response by conspecifics was observed.

At Nandankanan Biological Park courtship behaviour has been observed for several successive seasons. Maharana (pers. comm.) observed courtship in January and February and infers that the male uses the ghara as a hook on the female's snout for leverage when mounting. A photograph by R. Bedi (in Gore 1978) shows a male and female with crossed snouts, a feature of courtship behaviour also observed at MCB. The following is a description of one sequence. On 20 December 1977 at 1630 the 2.7 m male (without ghara) was observed to be on top of the female at the deepest end of the pond. The pair submerged briefly, surfaced and separated. At 1640 the

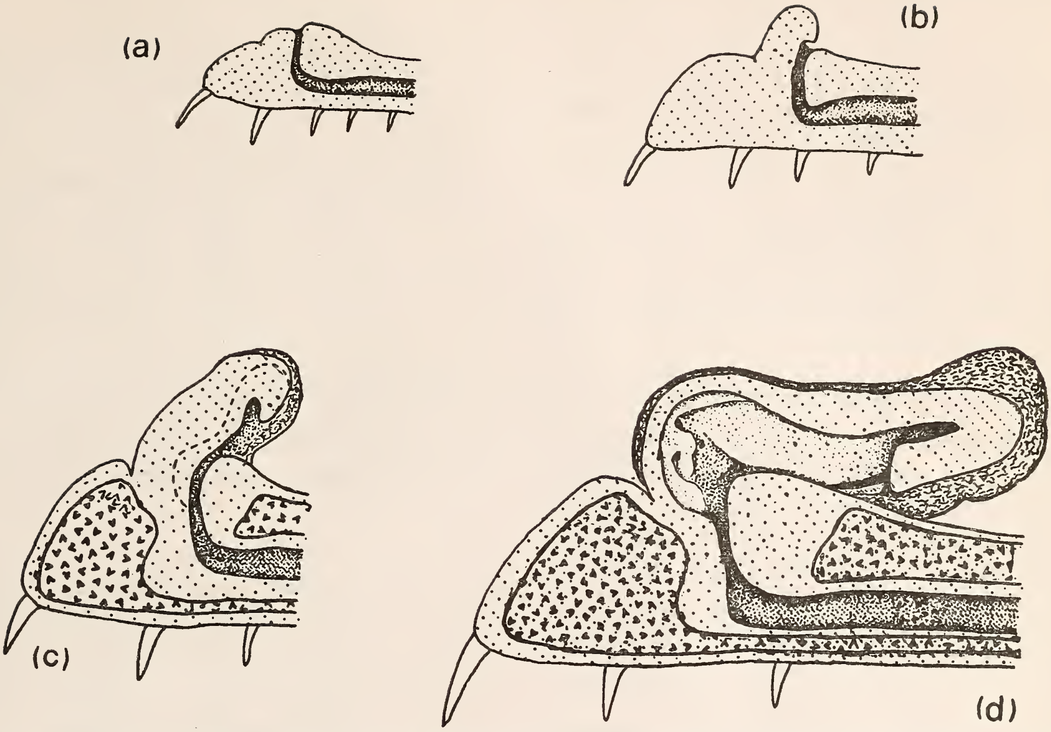


Fig. 1. Development of the ghara or narial excrescence of the male gharial (after Martin and Bellairs, 1977). (a) juvenile, (b) subadult, (c) subadult, (d) adult.

male approached the female. The female snapped at the male several times, bubbling and geysering small spouts of water from her nostrils. The male then crossed snouts with the female and swam behind her, he mounted and the pair submerged. A few minutes later the female surfaced among the weeds at the shallow end of the pond. The male approached her and when close, the female raised her head exposing the white underside of her throat. The male turned and swam away. Shortly thereafter the female swam toward a 2 year old, 1.25 m subadult and chased it out of the water. This was one of the few occasions in which aggression toward smaller animals was seen.

Nesting:

Nesting is strongly seasonal, occurring in March and April, during the period of high ambient temperatures and between the cold winter months (0-4°C) and the monsoon floods. Sites with fine sand are chosen in preference to banks of coarse sand. On the Chambal River the earliest nesting was recorded on 7th April. Anderson (1975) gives the first description of a gharial nest: 40 eggs buried in sand. The nest was in two layers of 20 with sand between. It is possible the female was disturbed during laying, resulting in the two tiers. The layer configuration of three nests on the Chambal was as follows:

Layer	Nest 1	Nest 2	Nest 3
1	20	20	13
2	20	20	23
3	4	7	—

It is presumed that the layers form by the action of gravity rather than by a deliberate effort of the female.

Gharial invariably dig their pitcher-shaped nest holes at night on steep sandy river banks. Singh and Bustard (1977) report the use of mud banks for nesting on the Chambal River after loss of sand banks from damming. The average nest hole is 40 cm deep and the spoor formation at trial nests confirms that the hind legs are used in digging, though Bustard (in litt.) saw a female engaged in apparent nest hole digging with her fore-limbs. Nests are located 1 to 5 m above the water level and up to 10 m away from the water's edge (Singh and Bustard 1977). The spoor of nesting females was found at a maximum distance of 22 m away from the river.

It is possible that gharial are communal nesters, as reported for the Nile crocodile (Cott 1961). Basu (1980) reports three nests on one 30 m sand bar on the Chambal and close proximity of nests at other sites. Trial nest holes are a common feature of gharial nesting. 5 females on the Karnali River (Nepal) made 12 trial holes without nesting. The digging of these trials is a manifestation of the nesting urge of the female (Bustard, in litt.). The depths of trial nest holes are compared below with actual nest holes.

Trial holes	Number	Range of depth	× depth
	23	27 — 52 cm	35.04 cm
Actual nest holes	22	20 — 54.5 cm	40.11 cm

Prior to the actual deposition of eggs gharial exhibit nesting behaviour consisting of movement to the vicinity of nest site, travel over the nest site and the digging of trial nests. In the Girwa river 4 females that had been basking on mid-river sand bars since mid February 1975, gave up the security of these basking sites and appeared below nesting sites on the right river bank on the morning of 31st March. One nest was located on 22nd April in which eggs were deposited on the previous night but nesting activity continued till the night of 29 April. Although trial digging was first noticed on the night of 15 April, the duration of the nesting period is computed to be 29 nights, that is, the date of first appearance below the nest sites to the post laying cessation of activity.

TABLE 1

HATCHLING MEASUREMENTS

Nest No.	N	Weight in grams Range	Weight in grams Average	Length in cms Range	Length in cms Average
1	50	96-126	116	35-38.5	35.7
2	38	82- 99	90	34.5-36.5	35.5
3	4	121-125	123	38-39	38.4
4	25	84-107	94	35-39	37.4
5	49	95-123	115	34-37.5	35.7
6	32	103-130	118	36-39.2	37.7

TABLE 2

GROWTH RATES

Year of Hatching	Age Class (year)	Number	Weight (Kg.) Range X	Length (cm) Range X
1976	4-5	6	27.5-36.0:31.8	209-218:212
1977	3-4	143	5.5-28.0:12.7	130-209:172
1978	2-3	196	1.0-11.0: 6.8	80-158:138
1979	1-2	91	0.35-4.5: 1.8	61-116: 88
1980	0-1	152	0.14-0.4: 0.6	42-66 : 56

On the Chambal River the spoor of an adult gharial (presumably a female) on 22 March indicated that the animal had travelled

TABLE 3

VERNACULAR NAMES OF GHARIAL

Language	Place	Vernacular name(s)
Urdu	Pakistan	Sansar
Hindustani	North India	Gharial (ghara=mud pot), nakaar
Bihari Hindi	Bihar	Nakaar, Basoolia nakaar (male)
Oriya	Orissa	Gharial (male), thantia (female)
Miching	Assam	Shormon
Bengali	West Bengal	Mecho kumhir (fish-eating crocodile)
Nepali	Nepal	Chimpta (pincers), thondre, lamthora

(Whitaker *et al.* 1974, Martin and Bellairs 1977)

more than 10 m. from the water without digging any trial nests. Activity continued for 21 nights till the night of 11 April, with the exception of the night of 31 March and 3 April. In this period 28 nest holes were dug with 7 holes being the maximum number in one night. In contrast to the protracted nesting activity of these sites a solitary nesting female using a site in a nesting area different from all other areas mentioned above deposited her eggs after a single night's nesting activity on the night of 5 April in which she dug only one other nest hole apart from the hole in which she deposited her eggs.

Singh and Bustard (1977) describe a nest of 25 eggs on Satkoshia Gorge being 5.9 m from the water's edge and 2.6 m above water level. The first eggs were 37.5 cm below the surface and the bottom of the nest hole measured 30 x 22.5 cm. In 23 nests on the Chambal and Girwa, the depth of sand covering the eggs averaged 29.03 cm. Depth of the nest hole averaged 48.89 cm and diameter 52.90.

The banks of the Chambal River can be broadly classified into the following types: 1) steep sand banks 2) flat sand banks 2) steep mud banks 4) flat mud banks 5) rocky banks. While nest hole excavation would be possible for gharial in bank types 1, 2 and 3 nesting was confined to river bank type 1) Alluvial deposits on a midriver rocky island were also used for nesting each season between 1976 and 1980. Between 1975 and 1980 all located gharial nests on the Girwa River in the Katerniaghat Sanctuary were found on a 3 km stretch of bank adjoining the highest land in the sanctuary. The same approximate sites are used each season but there are considerable alterations to the bank each year due to erosion and deposition during the monsoon high water. The Katerniaghat nest sites are therefore almost exclusively sandy subsoil exposed by erosion. Table 5 gives distances from and heights above water for 32 nests at 3 sites. Tables 6 and 7 give clutch sizes and female relatedness. Twelve nesting female gharial on the Chambal measured 3.16 m to 4.54 m (using the method described by Singh and Bustard 1977) with an average of 3.77 m; clutch sizes of these females has ranged from 10 to 64 eggs with an average of 42.

Incubation:

Observations on captive animals indicate an average egg development period of about

TABLE 4

DISPERSAL OF RELEASED JUVENILE GHARIAL (1979)

Locality	No.	Dispersal in one month	Dispersal in two months	Post monsoon dispersal
Chambal River, U.P.	15	200-500 m	<½ km	<5 km
Girwa River, U.P.	14	minimal	——	1-2 km

(Bustard 1979, Choudhury 1979)

TABLE 5

NEST SITUATION

	Nests	Distance from water (m)	Height above water (m)
A. Chambal	28	4.6-14.5:9.5	1.5-3.5:2.4
B. Girwa	3	2.5- 4.0:3.2	1.0-3.0:2.0
C. Mahanadi	1	5.9	2.5

(Singh & Bustard 1977)

TABLE 6

CLUTCH SIZE OF GHARIAL NESTS

Year	Place	Nests (N)	Clutch size (x)
1976	Girwa R., Chambal R.	10	45.8
1977	Girwa R., Chambal R.	18	39.5
1978	Girwa R., Chambal R.	16	39.2
1978	Rapti/Narayani R. (Nepal)	10	30.8
1979	Girwa R., Chambal R.	15	40.1
1980	Girwa R., Chambal R.	11	40.0

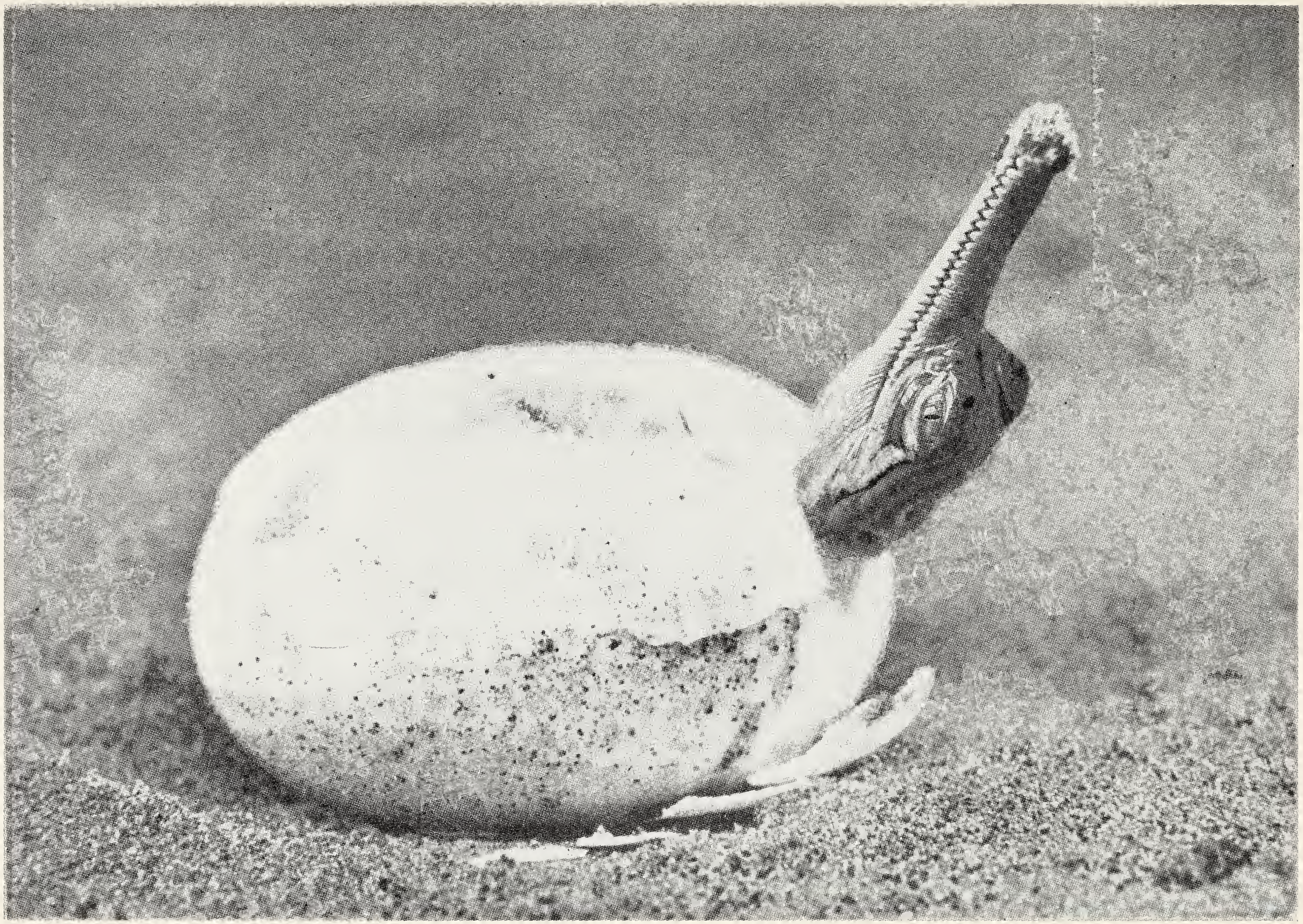
Number of eggs in 80 clutches = 3147; x = 39.3:18-95
(V. B. Singh 1979, Kimura 1978)

30-40 days as courtship was seen in first week February and eggs were laid on March 10th. Incubation periods in collected clutches from Nepal, Bihar and Orissa ranged from 71 to 93 days. In 1976 nests took 76 to 92 days to hatch, an average of 84.5 (Singh and Bustard 1977). Nests on the Chambal took an average of 60-65 days to hatch pointing to the tendency for captive incubation to be done at a lower temperature. The implications of temperature for determining the sex ratio of a clutch could however be very important. Collected clutches were incubated at an average temperature of 30°C. Singh and Bustard (pers. comm.) give a temperature range of 25 to 37°C for wild nests with a humidity (sand moisture content by weight) of 4% to 7%. Nests on the Chambal had temperatures at the top of the egg mass ranging from 22°C (in April) to 36.5°C (in May). Six nests monitored for 5 days in May had an average temperature of 34.9°C.

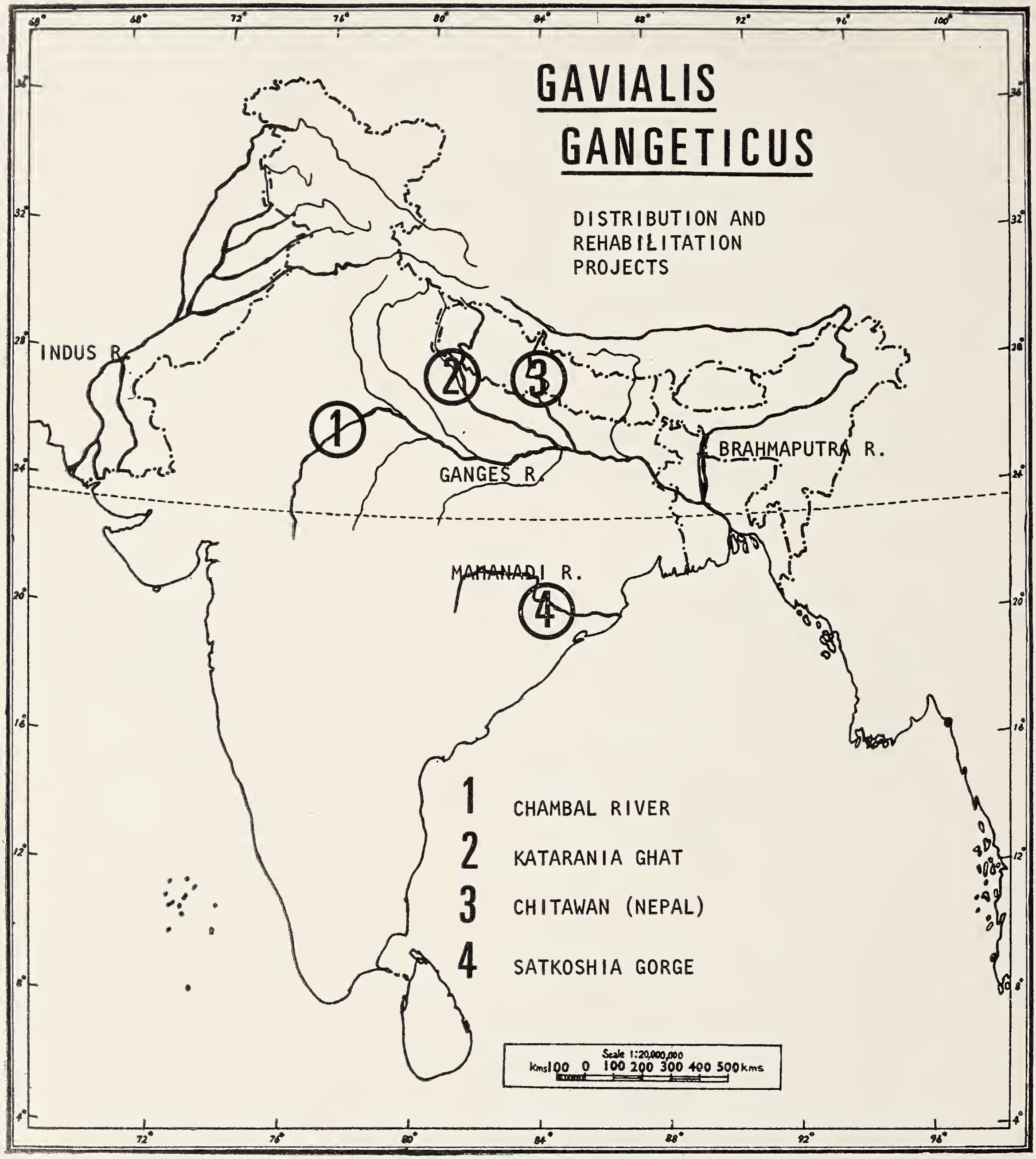
Breeding success:

Little is known about breeding success in the wild. The disturbed and altered status of gharial habitat may affect breeding success. For example Singh (pers. comm.) reports an infertile nest at Satkoshia Gorge where boat traffic is frequent enough that it may inhibit contact and mating.

All 70 nests found on the Chambal and Girwa Rivers between 1975-1980 were fertile. Bustard (in litt.) reported that 2.7% of eggs were damaged during laying in nests on the Narayani River in Nepal. 4.4% of the eggs in 12 nests collected in 1977 on the Girwa and Chambal Rivers were decomposed. In one nest only 5 hatchlings emerged from 49 eggs. The remainder died due to suffocation of the embryos when dune formation covered the site with 2 m of sand. One nest excavated naturally by the female was found to contain 45 hatched eggs, indicating 100% success. Most nests collected on the Girwa River have yielded hatchlings with congenital defects such as bent necks. These defects occur in up to 25%



Gharial hatching.
(Photo: *Rajesh Bedi*)


GAVIALIS GANGETICUS
DISTRIBUTION AND REHABILITATION PROJECTS
INDUS R.
GANGES R.
BRAHMAPUTRA R.
MAHANADI R.
1 CHAMBAL RIVER
2 KATARANIA GHAT
3 CHITAWAN (NEPAL)
4 SATKOSHIA GORGE
Scale 1:20,000,000
Kms100 0 100 200 300 400 500kms
68° 72° 76° 80° 84° 88° 92° 96° 100°
36° 32° 28° 24° 20° 16° 12° 8° 4°

Map of the Indian subcontinent showing the four main river systems of gharial distribution and location of the four rehabilitation projects.

TABLE 7

CLUTCH SIZE AND LENGTH OF FEMALE GHARIAL

Clutch size	Total length of female (cm)
15	270
30	300
41	330-360
44	330-360
56	288
44	344

(Hornaday 1885, Parshad 1914, Basu, pers. obs.)

TABLE 8

HATCHING SUCCESS OF COLLECTED GHARIAL EGGS IN UTTAR PRADESH

Year	Nests (N)	Eggs (N)	Hatchlings (N)	% success
1975	1	38	21	55.3
1976	10	458	364	79.5
1977	18	712	632	88.8
1978	16	627	432	68.9
1979	15	602	492	81.7
1980	11	440	373	84.8

(Singh 1979, Basu, pers. comm.)

of hatchlings in affected clutches and are surmised to be of genetic origin.

In Uttar Pradesh gharial eggs are generally left in the natural nest for over half the incubation period and then shifted to the hatchery by Forest Department personnel. Table 8 illustrates the high hatching success obtained (V. B. Singh 1979).

Hatching and post-hatching:

Singh and Bustard (1977) report the only incident of 'remnant' nest guarding behaviour. During May, 1976 at Kakaraghat, Narayani River, Nepal, a party of 12 persons approached a nest site. The female was basking at the site and entered the water on arrival of the team. While the eggs were collected she surfaced and remained close to the site.

On 8/4/75 a nest was laid in Satkoshia Gorge. The female visited the site 11 times in the following 77 days; the last three visits being on the 71st, 76th and 77th days, corresponding to possible hatching days (Singh and Bustard 1977). Hatching is in June, during the monsoon, with flood water and medium temperatures.

Singh and Bustard (1977) write that head morphology (sharp teeth, location of eyes, long snout and no space in mouth) preclude gharial from carrying hatchlings from the nest. Subsequently Basu and Bustard (in press) report evidence that gharial do excavate and carry their young to the water. It is possible that they carry eggs, as has also been reported in other crocodilians, but this has as yet to be observed or determined. It should be noted that the large gullet of an adult has ample room for hatchlings once in the back of the mouth.

Creche formation and protection of young has been reported by Singh and Bustard (1977). The authors record that in mid-July, 1974 an approximately 450 cm female gharial was seen in the shallows of a nullah off the Chambal River, Rajasthan. 34 hatchlings of about 375-400 mm were around and on her, some lying on her head and others on the nearby bank. Lang (pers. comm.) reports that the captive adult female at MCB responded to an imitation of a hatchling call by close approach and assuming a head-emergent at jawline posture. On July 14, 1979, 40 days post-hatching, a female was observed in the water below the nest site accompanied by 38 hatchlings. It is speculated that the creche lasts till the first rise of the river to flood level, which generally occurs by the end of July.

Captive breeding of gharial was achieved for the first time at Nandankanan Park, Orissa, in 1980. A 4 m male gharial on loan from the Frankfurt Zoo killed the 2.8 m resident male and in early 1980 mated with one of the two females. She laid 25 eggs on March 10th, all of which reportedly hatched 58 days later on May 7th.

Conservation:

Since 1975 intensive efforts to rehabilitate the seriously endangered gharial have met with considerable success. Under the consultancy of H. R. Bustard (FAO/UNDP), Forest Departments in the states of Orissa, Uttar Pradesh, Rajasthan and Bihar have evolved rehabilitation schemes. An estimated 100 wild gharial survived in India in 1975, half of the estimated world population. Collection of eggs and rearing the young at four main centres (Tikerpada in Orissa, Kukrail in Uttar Pradesh, Katerniaghat in Uttar Pradesh and Hyderabad in Andhra Pradesh) have so far resulted in a total of over 2000 hatchlings.

Riverine sanctuaries have been gazetted at Satkoshia Gorge (Orissa), Chambal River (Rajasthan, Uttar Pradesh, Madhya Pradesh), Katerniaghat (Uttar Pradesh) and Gandak River (Bihar) specifically for gharial rehabilitation. So far 107, 2-3 year old have been released in the Satkoshia Gorge Sanctuary, 75 in the Chambal National Gharial Sanctuary and 14 in the Katerniaghat Sanctuary. Studies on gharial biology are the subjects of four Ph.D. scholars and students on the fisheries and riverine ecosystems are planned to support the gharial programme (Basu and Singh, pers. comm.)

Captive breeding has occurred at Nandankanan Biological Park, Orissa and is being attempted at the Madras Crocodile Bank, Tamil Nadu.

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BREEDING HABITS AND ASSOCIATED PHENOMENON IN SOME INDIAN BATS

Part VII — *Hipposideros speoris* (Schneider) (Hipposideridae) from Chandrapur, Maharashtra

A. Gopalakrishna and Deepa Bhatia[2]

At and around Chandrapur (19°55′N., 79°28′E.) in Vidarbha (Eastern Maharashtra, India) *Hipposideros speoris* has an annual reproductive cycle, but all the females in the colony do not conceive synchronously. Copulation, followed immediately by ovulation and fertilization, takes place in different individuals of the colony on different dates from the last week of December to the second week of March. Sperms stored in the cauda epididymis are viable for over 2½ months after cessation of spermatogenetic activity. The accessory glands in the males remain in an active state for about two months after the regression of the testis. Gestation lasts for 135 to 140 days and deliveries in the colony occur from the 1st week of May to the last week of July. The left side of the female genitalia exhibits distinct physiological dominance over the right and a single young is delivered in each cycle. Whereas the females attain sexual maturity when they are 7½ to 8 months old, the males do not become sexually mature until they are at least 16 to 17 months old. There is an unbalanced sex-ratio with the females outnumbering the males.

INTRODUCTION

The breeding habits of *Hipposideros fulvus fulvus*, and *Hipposideros ater* have been described in previous parts of this series of papers on the breeding habits of Indian bats. *Hipposideros speoris,* which has an extensive distribution in India, has been chosen for detailed study because of the following important reasons: (1) It presents certain unique features not noticed in the other hipposiderid bats so far studied; (2) This is perhaps the first non-vespertilionid bat so far studied in which there is a protracted storage of spermatozoa in the epididymis even after the complete cessation of spermatogenetic activity in the testis; (3) The breeding behaviour of this species varies in important aspects in different localities. This species has been studied from two localities, Chandrapur district in Vidarbha and Nanded district in Marathwada. The present paper embodies observation on the species from Chandrapur. The report on the breeding habits of this species at Nanded will be reported separately.

MATERIAL AND METHODS

The specimens of *Hipposideros speoris* was collected at and around Chandrapur in Vidarbha district of Maharashtra State, India from 5th November 1977 to 14th May 1980

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such that every calendar month is represented by one or more collections. Altogether 1111 specimens were examined for the present report.

Hipposideros speoris is a small delicate bat, the body weight of the male and adult non-pregnant female being 9 to 10 g. They were found freely hanging from the roofs of dungeons in an old fort. Observations were also recorded on the nature of the external genitalia, condition and presence or absence of the mammary nipples and pubic dugs in the female. The position of the testis and the presence or absence of the 'pubic capsule' in the males were also noted. The reproductive organs and accessory structures were dissected out and fixed in various fixatives, such as Bouin's fluid, Rossman's fluid, 10% neutral formalin and Carnoy's fluid. After 24 hours of fixation the tissues were transferred to 70% ethanol, in which they were preserved. In the males the weight of the right testis was recorded with the help of a Mettler balance after fixation in 70% ethanol.

The characteristics of a batch of specimens collected on a calendar date or during a given week or a month were almost the same during the three years when the specimens were collected. Hence, only the month and date are mentioned in the following descriptions except where the mentioning of the year has some special significance.

A detailed collection diary giving the salient features of each specimen was maintained. Table I and Table II give the summary of the collection diary and monthwise collection of the specimens respectively.

OBSERVATIONS AND DISCUSSIONS

Externally, the female genitalia resemble those of most of the microchiroptera possessing bicornuate uterus. Morphologically the two cornua are symmetrical. An examination of serial sections of the female genitalia reveals that, unlike most other bats, *Hipposideros speoris* does not have a distinct cervical canal. Instead the two uterine cornua meet medially and form a common canal, which extends into the median limb of the 'Y' shaped genitalia for some distance, and the epithelium of the common canal, which is at first made up of columnar cells typical of the uterus, becomes imperceptably changed into the cornified squamous epithelium of the vagina. In *Tadarida brasiliensis cynocephala* (Stephens, 1962) and *Hipposideros fulvus fulvus* (Karim, 1975), the vaginal epithelium extends for some distance into the lateral limbs of the 'Y' shaped genitalia so that a distinct typical cervical canal is not present. The situation obtaining in *Hipposideros speoris* is, however, unwatched in any other bat. A pair of pubic dugs without mammary glands are present in the region of the groin in the parous females. A hard testis capsule surrounds the testis in adult males during November and December when vigorous spermatogenesis occurs.

1. *Breeding habits.* An examination of the collection diary and Table I reveals a number of interesting features. Females with unmistakable pregnancy, as evident by the occurrence of a bulbous uterine cornu, were available only during the period between the middle of January and the last week of July. Further, during January, February and March, although the majority of the females in each collection were nearly at the same stage of pregnancy thereby indicating that they had conceived nearly synchronously, there were a few females, which carried embryos at earlier stages of development, and had, therefore conceived later than the group of specimens

TABLE I

SUMMARY OF COLLECTION DIARY

Date	Immature		Adult	Total	Immature		Adult					Grand total
	Attached to mother	Free			Attached to mother	Free	Non-Pregnant	Pregnant		Lactating	Total	
								Right	Left			
1	2	3	4	5	6	7	8	9	10	11	12	13
1-1-79	—	1	9	10	—	—	—	—	—	—	—	10
2-1-80	—	—	2	2	—	—	3	—	18	—	21	23
4-1-79	—	—	6	6	—	—	—	—	—	—	—	6
7-1-80	—	1	3	4	—	—	1	—	2	—	23	27
9-1-79	—	—	1	1	—	—	—	—	—	—	—	1
18-1-80	—	2	3	5	—	—	—	—	4	—	4	9
13-1-80	—	3	3	6	—	—	1	—	—	—	1	7
26-1-79	—	1	5	6	—	—	—	—	—	—	—	6
29-1-78	—	—	7	7	—	—	—	—	8	—	8	15
6-2-78	—	—	8	8	—	—	1	—	5	—	6	14
6-2-80	—	—	2	2	—	—	—	—	6	—	6	8
15-2-78	—	—	1	1	—	—	1	—	18	—	19	20
17-2-79	—	—	6	6	—	—	—	—	1	—	1	7
28-2-78	—	1	5	6	—	—	1	—	15	—	16	22
9-3-78	—	—	2	2	—	—	—	—	21	—	21	23
13-3-79	—	—	—	—	—	—	—	—	2	—	2	2
24-3-78	—	—	2	2	—	—	—	1	11	—	12	14
5-4-78	—	—	2	2	—	—	—	—	12	—	12	14
9-4-78	—	—	2	2	—	—	—	1	17	—	18	20
12-4-79	—	—	—	—	—	—	—	—	11	—	11	11
26-4-78	—	—	—	—	—	—	—	2	16	—	18	18
26-4-79	—	—	—	—	—	—	—	1	11	—	12	12
29-4-78	—	—	6	6	—	—	—	1	11	—	12	18
1-5-80	—	1	6	7	—	—	—	—	8	—	8	15
2-5-80	1	—	1	2	—	—	—	—	3	1	4	6
10-5-78	1	—	2	3	—	—	—	—	7	1	8	11
14-5-80	1	2	5	8	2	—	—	—	2	9	13	21
17-5-78	—	3	4	7	—	—	—	3	1	4	8	15
23-5-78	5	—	2	7	8	—	—	—	—	16	24	31
26-5-79	3	—	1	4	2	1	3	—	—	4	10	14
30-5-78	7	—	2	9	6	—	9	—	—	6	21	30

1	2	3	4	5	6	7	8	9	10	11	12	13
5-6-78	5	—	3	8	6	—	—	—	—	15	21	29
13-6-78	12	—	2	14	5	—	—	—	—	14	19	33
13-6-79	1	—	2	3	1	—	—	—	—	7	8	11
21-6-78	—	—	3	3	—	—	10	1	1	15	27	30
30-6-78	1	2	2	5	2	1	13	—	—	9	25	30
4-7-78	—	—	3	3	—	2	8	2	—	11	23	26
15-7-78	1	2	2	5	—	4	10	—	—	3	17	22
24-7-79	1	4	1	6	—	2	4	—	—	1	7	13
29-7-78	—	6	1	7	1	3	7	—	—	8	19	26
30-7-79	—	1	7	8	—	2	2	—	—	3	7	15
11-8-78	—	2	8	10	—	2	5	—	—	7	14	24
13-8-78	—	—	5	5	—	2	4	—	—	—	6	11
24-8-78	—	6	3	9	—	1	6	—	—	7	14	23
4-9-78	—	2	2	4	—	1	6	—	—	3	10	14
14-9-78	—	3	9	12	—	3	11	—	—	4	18	23
25-9-79	—	2	2	4	—	2	3	—	—	—	5	9
29-9-78	—	2	6	8	—	—	17	—	—	—	17	25
13-10-79	—	1	—	1	—	1	9	—	—	—	10	10
14-10-78	—	7	5	12	—	3	5	—	—	—	8	20
24-10-78	—	1	1	2	—	6	11	—	—	—	17	19
5-11-77	—	—	3	3	—	—	9	—	—	—	9	12
8-11-78	—	1	7	8	—	—	8	—	—	—	8	16
14-11-79	—	—	4	4	—	—	8	—	—	—	8	12
16-11-78	—	3	1	4	—	—	19	—	—	—	19	23
22-11-78	—	—	5	5	—	—	16	—	—	—	16	21
24-11-79	—	1	2	3	—	—	10	—	—	—	10	13
28-11-77	—	—	1	1	—	—	11	—	—	—	11	12
30-11-78	—	2	4	6	—	—	14	—	—	—	14	20
5-12-79	—	—	—	—	—	—	11	—	—	—	11	11
7-12-78	—	3	3	6	—	—	15	—	—	—	15	21
10-12-79	—	—	2	2	—	—	8	—	—	—	8	10
14-12-77	—	—	3	3	—	—	—	—	—	—	—	3
14-12-78	—	3	9	12	—	—	10	—	—	—	10	22
15-12-79	—	5	6	11	—	—	3	—	—	—	3	14
26-12-78	—	1	10	11	—	—	3	—	—	—	3	14
28-12-79	—	2	1	3	—	—	—	1	9	—	10	13
29-12-77	—	—	3	3	—	—	—	—	—	—	—	3
Total	39	77	229	345	33	36	296	13	240	148	766	1111

mentioned above, and there were also few non-pregnant specimens. After about the middle of March until May all the females in the colony were pregnant, although at different stages of gestation. The first delivery occurred on 2nd May. During the following weeks more and more females delivered with the majority of deliveries occurring between 17th May and 13th June. After this date there was a progressive increase in the number of females in lactation and comparative decrease in the number of pregnant females in the colony. Since pregnancy commenced on different dates in different females, deliveries also took place on different dates in the colony. The last delivery in the colony occurred on 24th July. Females in lactation were collected from the beginning of May until 14th September. The young ones were carried by the mother until the former reached a body weight of about 6 g, after which the young ones were often noticed to become free from their mothers, crawling about among the other members of the colony and getting attached to any adult female in lactation for suckling. The maximum weight of the young one carried during flight by a mother was 8.5 g. On a few occasions more than one young were noticed sucking milk from the same mother simultaneously. Free young ones with a body weight of 9 g also had curdled milk in the stomach. These facts indicate that young ones suck milk for some time even after they get free from their mothers.

Table II

Monthwise collection of specimens

Month	♂♂	♀♀	Total
January	47	57	104
February	23	48	71
March	4	35	39
April	10	83	93
May	47	96	143
June	33	100	133
July	29	73	102
August	24	34	58
September	28	50	78
October	15	35	50
November	34	95	129
December	51	60	111
Total	345	766	1111

Microscopic examination of the female genitalia during November and December revealed that although copulation had occurred in some females on 7th December, and in many females during the following days until 25th December, as revealed by the presence of spermatozoa in the female genital tracts, ovulation had not taken place in any of these specimens. All the females (10) collected on 28th December 1979 had undergone ovulation and fertilization and had an embryo each. The youngest of the embryos collected on 28th December was a six-celled stage, which was present in the ovarian segment of the fallopian tube, and the most advanced embryo was a free unilaminar blastocyst in the cranial segment of the left uterine lumen. Since there was no evidence to indicate that there was any retarded early embryonic development or that there was delayed implantation of the blastocyst, the size of the most advanced embryo in this collection (free unilaminar blastocyst) indicates that ovulation followed soon by fertilization must have occurred in this specimen a maximum of 10 to 12 days before, that is, around 16th to 18th of December. Since many inseminated females, which had not undergone ovulation, were collected between 7th December and 25th December, it is evident that there is a short interval between copulation and ovulation, or there are repeated copulations during the first two weeks of December before copulation takes place in the middle of the third week of December in this species. The first female in the colony to deliver also must have been the first to have conceived. Since, the first conception has been shown to occur around the 16th to 18th of December and the first delivery was noticed on 2nd May, the gestation period of this species should be between 135 to 140 days, allowing a margin of two to three days on either side. Since the last specimen in the colony delivered on the 24th of July, after which there was not a single pregnant female in the colony, it is evident that this specimen must have conceived about the second week of March. The first batch of mothers, in which lactation had ceased, were collected on 21st June 1978. Assuming that these were the females, which had delivered the first batch of young ones in the colony (that is on 2nd May), it is evident that the period of lactation is about 50 to 55 days in this species. This conclusion is further supported by the fact that no female was found to be in lactation after the 14th of September which would be 53 days after the last delivery on 24th July. The foregoing observations lead to the following conclusions:

(i) Although *Hipposideros speoris* has an annual reproductive cycle, all the females in the colony do not conceive synchronously. (ii) The females of this species reach sexual maturity within the first year of their birth as evidenced from the fact that every female in the colony became pregnant during the breeding season. The absence of even a single non-pregnant female during this period was not an accident since the specimens were collected from several colonies during three consecutive years and at frequent intervals. This leads to the further conclusion that the young ones born in May (that is the first batch of young delivered in the colony) reach sexual maturity when they attain an age of about 7½ to 8 months and conceive along with the parous females in the colony during the latter half of December. This conclusion is based on the following facts. The females collected in December, which had either undergone copulation or which had embryos in the fallopian tube or the uterus, could be recognised into the following categories: parous animals, which could be identified since they had prominent pubic dugs and mammary nipples, and non-parous females, which had neither prominent pubic dugs and nor mammary nipples. The latter were evidently those which were experiencing their first pregnancy, and these were evidently the oldest non-parous females in the colony and, therefore, must have been the ones which were delivered in the first week of May. They were, thus, 7½ to 8 months old when they reach sexual maturity. Since the season of copulation extends from December to March, and it has been shown that the animals reached sexual maturity at about 8 months of age, and since deliveries take place during May to July in different specimens, there were females carrying conceptuses at different stages of development and also a few non-pregnant females during the period between December to March. Since different specimens were of different ages as they were delivered on different days, and since the specimens conceived when they reached an age of 7½ to 8 months of age, all the females in the colony were pregnant between March and May, because by about the middle of March even the last of young delivered in the previous year (that is, about the last week of July) also had attained sexual maturity as they had reached the requisite age.

Microscopic examination of adult males afforded strong circumstantial evidence to these conclusions. Although the testes regressed and there was a cessation of spermatogenetic activity, the cauda epididymis was full of spermatozoa and the accessory glands were in an active state until the end of April. Evidently, the adult males were sexually active and contained viable spermatozoa in their cauda epididymis until the end of April, and could successfully inseminate the females as they came to their first oestrus during January to March when they attained sexual maturity. This is why a group of females collected on any given date during January to March contained specimens at different stages of gestation and also a few non-pregnant ones, and why deliveries extended from May to about the last week of July.

2. *Growth and maturity.* As noted earlier, although *Hipposideros speoris* has an annual reproductive cycle, all the females in the colony do not conceive synchronously, and that females of this species reach sexual maturity within the first year of their birth. This conclusion is based on the following: The sexual maturity in females can be determined on the basis of the size and nature of mammary nipples and pubic teats taken along with pregnancy record. The mammary nipples and pubic teats are not present in the non-parous females. They develop during the first pregnancy and enlarge considerably during lactation, and remain as prominently visible pubic dugs throughout the rest of the life although they decrease slightly in size during the sexually quiescent period. Sexual maturity in the primiparous females in early pregnancy can be confirmed by microscopic examination of the ovaries which show a distinct extrovert corpus luteum. In the case of the males the examination of the collection diary, the weight and the histological structure of the testis and the size and structure of the accessory reproductive organs reveal that there were several immature males in the colonies during the breeding period. This indicates that the males of this species do not reach sexual maturity within the year of their birth and until they are at least 16 to 17 months of age assuming that the males born in July attain sexual maturity by December of the following year.

Immediately after birth the young get attached itself to the pubic dugs of the mother and are carried by it. The young ones are carried by there mother until the former reach a body weight of 6 g, after which the young ones were often noticed to be free from their mother. The highest weight of the attached young ones was 8.5 g.

During April-July many females in full lactation and having an unmistakable postpartum uterine cornu were noticed, thereby indicating that they had delivered recently. But they were not carrying a young at the breast. Evidently there is a considerable loss of young sucklings.

3. *Sex ratio.* Among 1111 specimens, collected at random, and at frequent intervals for nearly two years and a half, 766 were females, and 345 were males giving a sex-ratio of approximately 450 to 1000 females in the total population. Of the sucklings attached to the breast of the mothers 33 were females and 39 were males indicating a nearly even sex-ratio during this stage of life. Among the 925 adult specimens there were 696 females and 229 males. Since collections were made at random and from different colonies the above sex-ratio should represent the normal sex-ratio in this species at different periods of growths. Among the free juvenile specimens the males outnumbered the females (77 males and 37 females). This is because of the fact that, while the females reach sexual maturity within the year of their birth, the males do not attain sexual

maturity within the year of their birth and hence the free immature specimens were not of the same age group. The uneven sex-ratio is evidently due to the preferential mortality of the males.

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FIRST RECORDS OF ODONATES (ARTHROPODA: INSECTA) FROM THE SILENT VALLEY AND NEW AMARAMBALAM RESERVED FORESTS[1]

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and

A. R. Lahiri[3]

A list of 23 Odonate species constituting the first records of Odonate fauna of the Silent Valley and New Amarambalam Reserved Forests, Kerala, Southern India has been provided alongwith necessary collection data and field observations.

INTRODUCTION

The Silent Valley and the New Amarambalam Reserved Forests constitute the thickest evergreen tropical forests of the Western Ghats occupying the southwestern slopes of the Nilgiri plateau. The area surveyed covers the deciduous forests of Nilambur plains to the semi-evergreen and evergreen tropical forests of Silent Valley. Kuntipuzha in the Silent Valley and Cherrapuzha in the New Amarambalam Reserved forests are the main rivers which drain the respective forests. The Silent Valley, 45 Km north of Mannarghat in Palghat district of Kerala receives on an average an annual rainfall of 3000 mm. The temperature ranges between 44.67° F to 85°F.

Our knowledge of Odonate fauna of south India is confined to the works of Fraser (1924, 1932, 1933, 1934 & 1936) on the odonata fauna of Western Ghats, south of Maharashtra. The odonates of the Silent Valley and New Amarambalam Reserved Forests have not been reported on before.

The present study is based on the collections made by Dr. R. S. Pillai from the Silent Valley and by Shri K. R. Rao and Shri T. S. N. Murthy from the New Amarambalam Reserved Forests. Twenty-three species are reported in this paper out of which so far 4 are known only from Southern India especially from the Nilgiris, 13 are oriental in distribution, while the rest are widely distributed extending to the pacific islands.

SYSTEMATIC ACCOUNT

Suborder: Zygoptera

Family: CHLOROCYPHIDAE

Rhinocypha bisignata Selys

Rhinocypha bisignata Selys, 1853, *Syn. Cal;* 62; Fraser, 1934, *Fauna Brit. India, Odonata, 2*: 49.

Material: 2♂♂, 2 ♀♀, New Amarambalam Reserved Forest, Punjakolli, 23.ii.79. Coll. K. R. Rao.

Distribution: Sole representative of the genus from south India; Palni, Nilgiri and Shevaroy hills, Coorg and to a lesser extent at Khandala.

Remarks: Its larva was originally discovered in the Nilgiris. The species has a graceful flight and exhibits iridescent coloration while on wing. The species was observed to fly actively around a bush near the bank of Pumapuzha river.

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[1] Accepted March 1980.

[2] Zoological Survey of India, S. R. Station, Madras-28.

[3] Zoological Survey of India, Calcutta-12.

Neurobasis chinensis chinensis (Linnaeus)

Libellula chinensis Linnaeus, 1758, *Systema Naturae,* 1: 545.

Neurobasis chinensis (Linnaeus): Kirby, 1890. *A synomymic Catalogue of Neuroptera Odonata,* 102.

Neurobasis chinensis chinensis (Linnaeus): Ris. 1915, *Tijdschr, Ent; 58*: 6; Fraser, 1934, *Fauna Brit. India, Odonata, 2*: 121.

Material: 2 ♀ ♀, Silent Valley, South of 2nd Camp, 25.i.79, Coll. R. S. Pillai.

Distribution: India, Sri Lanka, Burma, Indochina and Malaysia.

Remarks: Both pairs of wings possess a remarkable deep tint of burnt brown, and pterostigma is present on the hind wings only. This species was seen near fast flowing streams and the specimens were collected .from the banks of Kunti River.

Vestalis apicalis apicalis Selys

Vestalis apicalis Selys, 1873, *Bull. Acad. r. Belg.* (2) *36*: 612.

Vestalis apicalis apicalis Selys: Fraser, 1929, *J. Bombay nat. Hist. Soc., 33*: 583; 1934, *Fauna Brit. India, Odonata 2*: 128.

Material: 2 ♂ ♂, New Amarambalam R. F. Punjakolli, 22.iii.79; 1 ♀, 23.iii.79, Coll. K. R. Rao.

Distribution: Throughout the oriental region.

Remarks: This species was found flying gracefully in the company of the next species. The species usually rests on bushes in heavy shade.

Vestalis gracilis montana Fraser

Vestalis gracilis montana Fraser, 1934, *Fauna Brit. India, Odonata 2*: 128.

Material: 1 ♂, 1 ♀, 23.iii.79, 1 ♀, Amarambalam R. F. Punjakolli, 26.iii.79, Coll. K. R. Rao.

Distribution: S. India; Coorg and the Nilgiri, Wynad.

Remarks: This was found to fly in the company of *Vestalis apicalis apicalis* Selys and *Protosticta hiersevi* Fraser. This species also exhibits the same behaviour as the previous species.

Family: PLATYSTICTIDAE

Protosticta hiersevi Fraser

Protosticta hiersevi Fraser, 1922, *Rec. Indian Mus., 24*: 5: 1933, *Fauna, Brit. India, Odonata 1*: 113.

Material: 1 ♂, 1 ♀, New Amarambalam R. F. Punjakolli, 23.iii.79, Coll. K. R. Rao.

Distribution: S. India: Nilgiris, Anaimalais and Travancore.

Remarks: The female has an extra post model vein in both wings. The abdomen measures 35 mm instead of the usual length of 32 to 33 mm. This species was found in the company of the two species described above. It has a cupreous shining colour and is small in size.

Family: PLATYCNEMIDAE

Copera marginipes (Rambur)

Platycnemis marginipes Rambur, 1842, *Hist. nat. ins. Nevropteres,* 240.

Copera marginipes (Rambur): Kirby, 1890, *A synomymic catalogue of Neuroptera Odonata,* 129; Fraser, 1933, *Fauna Brit. India, Odonata, 1*: 192.

Material: 1 ♂, 11 km, from 3rd Camp of Silent Valley, 1.ii.79, Coll. R. S. Pillai.

Distribution: India, Nepal, Burma and Malaysia in the East.

Remarks: The species was collected from Bamboo forests along the banks of stagnant water bodies. The species shows a number of variations.

Copera vittata (Selys)

Psilocnemis vittata Selys, 1863, *Bull. Acad. Belg.* (2): 170.

Copera vittata (Selys): Kirby, 1890, *A synomymic catalogue of Neuroptera Odonata,* 117; Fraser, 1933, *Fauna Brit. India, Odonata, 1*: 198.

Material: 2 ♂ ♂, New Amarambalam R. F. Punjakolli, 23.iii.79, Coll. K. R. Rao.

Distribution: Widely distributed throughout southern Asia.

Remarks: The species rests on bushes in heavy shade near the bank of Pumapuzha.

Family: COENAGRIONIDAE

Ceriagrion auranticum Fraser

Ceriagrion auranticum Fraser, 1923, *J. Bombay nat. Hist. Soc., 29*: 748.

Ceriagrion auranticum Fraser: Asahina, 1967, *Jap. J. Zool., 15*(3): 307.

Material: 3♂♂, New Amarambalam R. F. Sayivala, 16.iii.79; 1♂, Punjakolli, 22.iii.79, Coll. K. R. Rao.

Distribution: Restricted to the Western Ghats around Nilgiri Wynad.

Remarks: Reddish brown dragonflies collected well away from water. The species usually keeps to scrub or tall grass.

Pseudagrion malabaricum Fraser

Pseudagrion malabaricum Fraser, 1924, *Rec. Indian Mus; 26*: 494; 1933, *Fauna Brit. India, Odonata, 1*: 284.

Material: 2♂♂, New Amarambalam R. F. Nedungayam, 23.iii.79, Coll. K. R. Rao.

Distribution: Throughout the Western Ghats: Coorg, Kodaikanal, Nilgiris, Ootacamund, Palni hills and in Sri Lanka.

Remarks: Collected near stagnant water adjacent to Krimpuzha river. Usually they are found in great numbers and their presence and their colour literally makes the area look blue.

Aciagrion hisopa (Selys)

Pseudagrion hisopa Selys, 1876, *Bull. Acad. Belg. Cl. Sci.* (2), *42*: 509.

Aciagrion hisopa (Selys): Selys, 1891, *Ann. Mus. CIV Genova, 30*: 512; Fraser, 1933, *Fauna Brit. India, Odonata, 1*: 340.

Material: 1♂, New Amarambalam R. F. Sayivala, 16.iii.79, Col. K. R. Rao.

Distribution: India, Burma, Sri Lanka and Malaysia.

Remarks: The specimens were collected from the banks of a small stream in a bamboo forest.

Ischnura aurora aurora (Brauer)

Agrion delicatum Hagen, 1858, *Verh. Zool. Bot. Ges. Wien. 8*: 479.

Ischnura delicata (Hagen): Selys, 1876, *Bull. Acad. r. Belg. cl. Sci.* (2) *41*: 281; Fraser, 1933, *Fauna Brit. India, Odonata, 1*: 360.

Ischnura aurora (Brauer): Ris, 1915, *Nova Caledonia, Zool., 2*(4): 67.

Ischnura aurora aurora (Brauer): Lieftinek, 1949. *Nova Guinea* (New Ser.) *5*: 220.

Material: 1♂, 1♀, Silent Valley, 11 km from 3rd Camp, 1.ii.79; 1♂, around 3rd Camp 4.ii.79, Coll. R. S. Pillai.

Distribution: Widely distributed throughout southern Asia, India, Sri Lanka, Burma, Malaysia, New Guinea, Australia, Philippines.

Remarks: This species has remarkable powers of flight and making use of upper air currents has spread all over southeast Asia.

Agriocnemis pieris Laidlaw

Agriocnemis pieris Laidlaw, 1919, *Rec. Indian Mus; 16*: 180; Fraser, 1933, *Fauna Brit. India, Odonata, 1*: 384.

Material: 1♂, New Amarambalam R. F. Nedungayam, 28.iii.79, Coll. K. R. Rao.

Distribution: Western Ghats, from Castle Rock to Malabar, Nilgiris and Coorg.

Remarks: The specimens were collected from the banks of stagnant pools surrounded by grass.

Agriocnemis splendidissima Laidlaw

Agriocnemis splendidissima Laidlaw, 1919, *Rec. Indian Mus; 16*: 180; Fraser, 1933 *Fauna Brit. India, Odonata, 1*: 392.

Material: 1♂, Silent Valley, 11 km. from 3rd Camp 1.ii.79, Coll. R. S. Pillai; 1♂, New Amarambalam R. F. Nedungayam, Coll. K. R. Rao.

Distribution: Poona, Mhow, Khandala, Malabar; Nilgiris and Coorg.

Remarks: The specimens were collected from beds of stagnant water bodies or narrow streams with grasslands around.

Family: LIBELLULIDAE
Sub-Order: Anisoptera

Orthetrum chrysis Selys

Libella testacea race *chrysis* Selys, 1891, *Ann. Mus. civ.* Genova, 30, 462.

Orthetrum chrysis Selys: Ris, 1900, *Archiv, fur, Natur., 1*: 86; Fraser 1936. *Fauna Brit. India, Odonata, 3*: 310.

Material: 1 ♂, Silent Valley, *c.* 2 km. away from 3rd Camp 3.ii.79, Coll. R. S. Pillai.

Distribution: India: Chanan in Travancore border, Kotagiri, in Nilgiris; Sri Lanka; Burma and Malaysia.

Remarks: Collected from the beds of small mountain streams.

Orthetrum pruinosum neglectum (Rambur)

Libellula neglecta Rambur, 1842, *Hist. nat. Ins. Nevropteres,* 86.

Libellula pruinosa (Brauer) 1868, *Verh, Zool. Bot. Ges. Wien; 15*: 1013.

Orthetrum pruinosum (Brauer): Kirby, 1886, *Proc. Zool. Soc. Lond*; 327.

Orthetrum pruinosum neglectum (Rambur): Ris. 1909, *Collections Zool. du Baron, Ee de* Selys — *Long champs, 9*: 181; Fraser, 1936. *Fauna Brit. India, Odonata, 3*: 311.

Material: 1♂, 1♀, Silent Valley, Mukkali, 18.i.79, Coll. R. S. Pillai.

Distribution: Throughout India, Sri Lanka, Burma extending to Tibet, Indochina, and Hongkong.

Remarks: Collected near a forest stream in soft wood plantation. This species occurs everywhere from plains to an altitude of 7250′.

Orthetrum sabina (Drury)

Libellula sabina Drury, 1770, *Illustrations of Natural History, 1*: 114.

Orthetrum sabina (Drury): Kirby, 1889, *Trans. Zool. Soc., Lond.; 12*: 302; Fraser, 1936, *Fauna Brit. India, Odonata, 3*: 300.

Material: 1♂, New Amarambalam R. F. Punjakolli, 22.iii.79, Coll. K. R. Rao.

Distribution: Throughout India, Sri Lanka, Burma and ranging from Somaliland, Persia to Samoa and Australia.

Remarks: Collected from the bank of a narrow stream away from the main river Olikatodu.

Indothemis caesia (Rambur)

Libellula caesia Rambur, 1842, *Hist. nat. ins. Nevropteres,* 95.

Indothemis limbata (Rambur): Ris, 1911, *Collections Zool. de Baron E. de* Selys — *Longchamps, 12*: 529.

Indothemis caesia (Rambur): Fraser, 1936, *Fauna Brit. India, Odonata, 3*: 340.

Material: 1♂, New Amarambalam R. F. Punjakolli, 21.iii.79, Coll. K. R. Rao.

Distribution: Masinagudi at the foot of Sigur Ghats in Nilgiris, Hasimara, West Bengal and one specimen recorded from Bangkok.

Remarks: Collected from burnt down patches of soft wood forest area.

Crocothemis servilia servilia (Drury)

Libellula servilia Drury, 1770, *Illustrations of Natural History, 1*: 112.

Crocothemis servilia servilia (Drury): Fraser, *Fauna Brit. India, Odonata, 3*: 345.

Material: 1♂, Silent Valley South of 2nd Camp, 25-1-79, Coll. R. S. Pillai.

Distribution: Mesopotamia, India, Sri Lanka and Burma; S. Asia to Japan, the Philippines and Australia and southwards to Sunda Archipelago.

Remarks: Collected from the banks of Kunti river.

Diplacodes trivialis (Rambur)

Libellula trivialis Rambur, 1842, *Hist. Nat. Ins. Nevropteres,* 115.

Diplacodes trivialis (Rambur): Karsch, 1891, *Ent. Nachr. 17*: 246: Fraser, 1936, *Fauna Brit. India, Odonata, 3*: 337.

Material: 1 ♀, Silent Valley, Kantipuzha, 17.i.79, Coll. R. S. Pillai; 1♂, Silent Valley, Eastern side of camp, Coll. R. S. Pillai; 1♂, *c.* 11 km. from 3rd Camp 1.ii.79. Coll. R.

S. Pillai; 3♂♂, 4♀♀, 21-26.iii.79, New Amarambalam R. F. Punjakolli, Coll. K. R. Rao; 1♀, 14.iii.79, Sayivala, Coll. K. R. Rao.

Distribution: Ranges from Seychelles to the Pacific through India, Sri Lanka, Burma, S. Asia to Formosa and the Philippines.

Remarks: It is one of the commonest dragonflies found in India. Often seen on roadsides where it rests on grass. Distributed at all elevations.

Neurothemis fulvia (Drury)

Libellula fulvia Drury, 1773, *Illustrations of Natural History, 2*: 84.

Neurothemis fulvia (Drury): Kirby, 1889, *Trans. Zool. Soc. Lond., 12*: 271; Fraser, 1936, *Fauna Brit. India, Odonata, 3*: 353.

Material: 1♂, New Amarambalam R. F. Meenmutty, 19.iii.79, Coll. T. S. N. Murthy; 1♂, Punjakolli, 23.iii.79, Coll. K. R. Rao.

Distribution: India, sparingly distributed all over southwest India and parts of Tamilnadu, Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal, Assam and Tripura; Nepal; Indochina and Sumatra in the East.

Remarks: This species has been collected from shady jungle streams. It usually occurs in wet and semi-wet areas especially in the submontane regions.

Neurothemis intermedia intermedia (Rambur)

Libellula intermedia Rambur, 1842, *Hist. Nat. Ins. Nevaropteres,* 91.

Neurothemis intermedia (Rambur) Selys, 1889, *Ann. Mus. Civ. Genova* 27: 454.

Neurothemis intermedia intermedia (Rambur): Ris, 1911, *Collections Zool. dw Baron E. de* Selys *Long champs, 13*: 551; Fraser, 1936, *Fauna Brit. India, Odonata, 3*: 357.

Material: 1♂, Silent Valley, 2nd Camp, 22.i.79, Coll. R. S. Pillai; 2 ♀♀, 2 km from 3rd Camp, 3.ii.79, Coll. R. S. Pillai; 1♂, around 3rd Camp 4.ii.79, Coll. R. S. Pillai; 11♂♂, 15♀♀, New Amarambalam R. F. Sayivala, 15 to 19.iii.79, Coll. K. R. Rao; 13♂♂, 9♀♀, Punjakolli, 21-26.iii.79, Coll. K. R. Rao.

Distribution: India, Sri Lanka, Nepal, Indonesia and Western Thai.

Remarks: The species has a weak flight. Collected from the banks of forest streams.

Neurothemis tullia tullia (Drury)

Libellula tullia Drury, 1773, *Illustrations of Natural History, 2*: 85.

Neurothemis tullia (Drury): Kirby, 1890, *A synonymic catalogue of Neuroptera Odonata,* 8.

Neurothemis tullia tullia (Drury): Fraser, 1936, *Fauna Brit. India, Odonata, 3*: 360.

Material: 1♂, 3♀♀, New Amarambalam R. F. Sayivala, 16 to 19.iii.79, Coll. K. R. Rao; 9♂♂, 4♀♀ Punjakolli, 26.ii.79, Coll. K. R. Rao; 10 Nedungayam, 28.iii.79, Coll. K. R. Rao.

Distribution: India, Sri Lanka; Nepal; Indonesia and Northern Thai in the East.

Remarks: Collected from weedy streams in the forest. Its flight is short and weak. They have protective coloration.

Trithemis aurora (Burmeister)

Libellula aurora Burmeister, 1839, *Handbuch der Entomologie, 2*: 859.

Trithemis aurora (Burmeister): Brauer, 1868, *Verh. Zool. Bot. Ges. Wien.,* 18: 177; Fraser 1936, *Fauna Brit. India, Odonata, 3*: 383.

Material: 2♂♂, 1♀, New Amarambalam R. F. Punjakolli, 21-22.iii.79, Coll. K. R. Rao.

Distribution: India; Tibet; Nepal; Philippines; Malaysia and Indonesia.

Remarks: They were seen to rest on herbage along the banks of forest streams. Males are very active. Females wander far away from water.

ACKNOWLEDGEMENTS

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NOTES ON THE OCCURRENCE OF SOME PLANTS OF WEST BENGAL[1]

J. K. Sikdar[2]

During the course of intensive botanical collections in Jalpaiguri district of West Bengal and consultations at Central National Herbarium (CAL) and Herbarium of the Industrial Section, Indian Museum (BSIS), I studied the following plants which are interesting in respect of their occurrence in West Bengal. In addition to previous communications on the distribution of some plants in Jalpaiguri district as well as in West Bengal, notes on the occurrence of twelve more taxa in Jalpaiguri and Darjeeling districts and other parts of West Bengal are given here with their correct nomenclature.

Balsaminaceae

Impatiens decipiens Hook. f. in Rec. Bot. Surv. India 4: 17 & 22. 1905; Hara, Fl. East. Himal. 195. 1966.

Flowering & fruiting: June to October.

Specimens examined: West Bengal: Darjeeling district — Pomong, ± 850 m (Acc. No. 71392), (CAL).

Distributional note: This plant has so far been known only from the type localities-Sikkim and Chumbi (J. D. Hooker, 1905) and South Tibet.

I. gamblei Hook f. in Rec. Bot. Surv. India 4: 15 & 20. 1905.

Flowering & fruiting: May to October.

Specimens examined: West Bengal: Darjeeling district — between Sandakphu and Phallut, ± 4000 m, 19 Oct. 1904, *Burkill* 25229 (CAL); Birch Hill, ± 2200 m, 11 May, 1940, *K. Biswas* 4833 (CAL).

Distributional note: This species was previously recorded from Sikkim and Chumbi only by J. D. Hooker (1905).

I. gammiei Hook f. in Rec. Bot. Surv. India 4: 16 & 21. 1905.

Flowering & fruiting: September to October.

Specimens examined: West Bengal: Darjeeling district — South of Subarkum, ± 4000 m, 1 Oct. 1906, *Burkill* 27688 (2-gatherings) (CAL); 5 miles north of Sandakphu, ± 4000 m, 28 Sept. 1906, *Burkill* 27619 (CAL).

Distributional note: This taxon was previously known to occur in Sikkim and Arunachal Pradesh in India.

I. wallichii Hook. f. in Rec. Bot. Surv. India 4: 15 & 20. 1905; Hara in Ohashi, Fl. East. Himal. 3rd Rep. (Bull. No. 8): 79. 1975.

Flowering & fruiting: July to October.

Specimens examined: West Bengal: Darjeeling district — Tongloo, ± 3000 m, 3 Aug. 1862, without Collector's name & number (CAL); Phullalong, ± 3000 m, 5 Oct. 1870, without Collector's name, 12688 (CAL); Sandakphu, ± 4000 m, Sept. 1880, *J. S. Gamble* 8423 (CAL); Sandakphu west, ± 1200 m, 16 Sept. 1962, *B. Safui* 1703 (CAL).

Distributional note: It was recorded so far from Sikkim and Nepal by Hooker (1905) and Hara (1975). Of the above cited speci-

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[1] Accepted September 1981.

[2] Central National Herbarium, Botanical Survey of India, Howrah-711 103.

mens, the specimens from Tongloo and Phullalong have Hooker's signature on the sheets. As Hooker (1905) mentioned Sikkim as one of the localities, it is presumed that the specimens studied by Hooker himself as evidenced from his signature are from Darjeeling district. Hence the present record of the species from West Bengal is an additional locality.

COMPOSITAE

Lactuca dolichophylla Kitamura in Res. Kyoto Univ. Sci. Exped. Karak. & Hinduk. 1955, viii. (Addit. & Corr. Fl. Afghan.) 150, March 1, 1966 et in Hara, Fl. East. Himal. 341. 1966. *Mulgedium sagittatum* Royle, Ill. Bot. Himal. 252, t. 61, f. 2. 1835, not *Lactuca sagittata* Wald. et Kit. (1802). *Lactuca longifolia* DC. Prodr. 7: 135. 1835; Clarke, Comp. Ind. 264. 1876; Hook. f., Fl. Brit. Ind. 3: 405. 1881.

Flowering & fruiting: September to October.

Specimen examined: West Bengal: Jalpaiguri district — on way to Buxaduar, 850 m, Buxaduar forest range, rare in open rocky hill slopes, 15 Sept. 1976, *J. K. Sikdar* 7825 (CAL)

Distributional note: It is known to occur in Kashmir, Himachal Pradesh and Uttar Pradesh in India and in Nepal, Afghanisthan, Pakistan and W. China.

APOCYANACEAE

Anodendron paniculatum DC. Prodr. 8: 444. 1844; Hook. f., Fl. Brit. Ind. 3: 688. 1882; Prain, Bengal Plants 2: 504. 1903 (repr.); Haines, Bot. Bihar & Orissa 2: 572. 1922 (repr.); Das in Kanjilal & Das, Fl. Assam 3: 270. 1939.

Flowering: February to May.

Fruiting: January.

Specimen examined: West Bengal: Jalpaiguri district — around Poro forest bungalow, Nimati forest range, 2 Apr. 1973, *Bijoy Krishna* 464 (BSIS).

Distributional note: It is distributed in Bangladesh, Burma, Sri Lanka, Malaya Peninsula, Malesian Islands, Philippines and in India known to occur in Arunachal Pradesh, Assam, Mizoram, Bihar, Orissa, Maharashtra, Karnataka, Kerala and Andaman & Nicobar Islands. Prain (1903) recorded this species from Chittagong (Bangladesh).

SCROPHULARIACEAE

Lindenbergia hookeri Clarke ex Hook. f., Fl. Brit. Ind. 4: 261. 1884; Das in Kanjilal & Das, Fl. Assam 3: 378. 1939; Prijanto in Reinwardtia 7: 555. 1969; Yamazaki in Ohashi, Fl. East. Himal. 3rd Rep. (Bull. No. 8): 98. 1975.

Flowering & fruiting: February to May.

Specimens examined: West Bengal: Jalpaiguri district — on way to Buxaduar, 650 m, Buxaduar forest range, rare along the valleys and rocky situations on the lower hills, 28 Feb. 1934, *K. Biswas* 1755 (CAL); Bengal & borders-without precise locality and date of collections, *V. Narayanswami & Party* 2589 (2-gatherings) (CAL).

Distributional note: It was recorded so far from Assam, Meghalaya, Sikkim and Bhutan.

L. macrostachya (Benth.) Benth. Scroph. Ind. 22. 1835; Hook. f., Fl. Brit. Ind. 4: 262. 1884; Prinjanto in Reinwardtia 7: 554. 1969; G. Raizada in Ind. Jour. For. 1(2): 153. 1978. *Stemodia macrostachya* Benth. (in Wallich, Cat. 3925. 1831, nomen) Bot. Reg. 17: t. 1470. 1832.

Flowering & fruiting: March to May.

Specimen examined: West Bengal: Herb. Griffith 3883/1 (Acc. No. 321664) (Distributed at the Royal Botanic gardens, Kew, 1862-3), (CAL). Generally grows along valleys, river banks, rocky places and in roadside wastelands.

Distributional note: It occurs in Nepal, West Pakistan, Siam, China and Kashmir, Punjab, Uttar Pradesh, Bihar, Himachal Pradesh in India. A single earlier collection by Griffith from West Bengal is thus mentioned here as a new distributional record of the species from the state.

Hooker (1884) pointed out that this species is "perhaps only a variety of *L. philippensis* (Cham.) Benth. but more glabrous, with shorter petioles". Usually, *L. macrostachya* (Benth.) Benth. is often confused in its general morphology with *L. philippensis* (Cham.) Benth. It is distinguished by lax interrupted inflorescence with smaller flowers, triangular calyx lobes with acute tips, ± triangular posterior lip of corolla, comparatively shorter corolla tube and glabrous ovary and style base.

ACANTHACEAE

Dianthera virgata (Wall. ex Nees) C. B. Clarke in Hook. f., Fl. Brit. Ind. 4: 542. 1885. *Leptostachya virgata* Wall. ex Nees in Pl. Asiat. Rar. 3: 105. 1832. *Justicia virgata* Wall. (Cat. 7177) ex T. Anders. in Journ. Linn. Soc. 9: 516. 1867. *Dianthera virgata* Benth. in Gen. Pl. 2: 1114. 1873; Thothathri in Rec. Bot. Surv. Ind. 20(2): 163. 1973.

Flowering & fruiting: November.

Specimens examined: West Bengal: Jalpaiguri district — Lapchakhawa, ± 1200 m, Buxaduar forest range, rare in shady moist situations on the hill slopes, 27 Nov. 1975, *J. K. Sikdar* 972 (CAL).

Distributional note: This species has so far been known only from Manipur, Arunachal Pradesh, Meghalaya, Sikkim in India and Bhutan and Burma. The present collection of the species after a lapse of more than 100 years from Jalpaiguri district shows its extended distribution in Eastern India and is being recorded here from West Bengal for the first time.

VERBENACEAE

Clerodendrum philippinum Schauer, DC. Prodr. 11:667. 1847. ('Clerodendron'); Howard and Powell, Taxon 17: 54. 1968. *Volkameria japonica* Jacq. Hort. Schoenbr. 3: 48, t. 338. 1798. *Clerodendron fragrans* Hort. ex Vent. Jard. Malm. 2: t. 70. 1804; C. B. Clarke in Hook. f., Fl. Brit. Ind. 4: 589. 1885; Prain, Bengal Plants 2: 624. 1903 (repr.).

Flowering: November to May.

Specimens examined: West Bengal: Jalpaiguri district — Chunabhati, ± 1200 m, Buxaduar forest range, frequent in grassy areas along the rocky forest paths and here and there on the hill slopes, 28 Nov. 1975, *J. K. Sikdar* 995 (CAL); Buxaduar, ± 1000 m, Buxaduar forest range, along the hillslopes, 29 Nov. 1975, *J. K. Sikdar* 4026 (CAL); Buxaduar to Chunabhati, ± 1100 m, Buxaduar forest range, 12 May, 1976, *J. K. Sikdar* 4591 (CAL).

Distributional note: It is known to occur in Assam, Tripura, Meghalaya, Bihar, Delhi, Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu in India and in China, Japan, United States, Mexico, West Indies, Central America, Argentina, and Chile. This report of the species from West Bengal is a record of its naturalisation in the flora of Jalpaiguri district, as an escape.

POLYGONACEAE

Peraicaria tenella (Bl.) Hara in Jour. Jap. Bot. 44: 375. 1969; Fl. East. Himal. 23. 1971. *Polygonum tenellum* Bl., Bijdr. 530. 1825, non Roxb. 1832. var. *kawagoeana* (Makino) Hara in Jour. Jap. Bot. 375. 1969. *P. kawagoeana*

Makino in Bot. Mag. Tokyo 28: 115. 1914. *P. minus* Hudson (Fl. Angl. ed. 1, 148. 1762, *non vidi*) sensu Fl. Brit. Ind. 5: 36. 1886, p.p.; Prain, Bengal Plants 2: 663. 1903 (repr.). *P. minus* subsp. *micranthum* (Meisn.) Danser in Bull. Jard. Bot. Buitenz. Ser. 3, 8: 176, f. 8. 1927.

Flowering & fruiting: April to December.

Specimens examined: West Bengal: Jalpaiguri district — Balapara, Bholka forest range, rare in muddy situations towards the extreme eastern border of the district, 6 Dec. 1975, *J. K. Sikdar* 4163 (CAL).

Distributional note: This taxon was recorded from Assam, Meghalaya, Arunachal Pradesh, Manipur, Sikkim, Madhya Pradesh, Tamil Nadu in India and also from Nepal, Bhutan, Bangladesh, Burma, Malaysia, China, Japan and Europe. It was known from West Bengal from a single specimen in CAL, collected by Thornton Ripley from Kalimpong on 18.7.1914, which was cited by Danser (1927). A recent collection by K. Thothathri on 6.11.1960 (CAL) from Kalimpong approaches the present taxon, but on critical examination it was identified as *Persicaria tenella* (Bl.) Hara var. *kawagoeana* (Makino) Hara which was considered by Danser (1927) and Hara (1969, 1971). The present collection which is also identical with the Wallich's specimen (Wall. Cat. 1722) from Nepal after a lapse of about 65 years is thus interesting and establishes its occurrence in West Bengal.

URTICACEAE

Pilea peploides (Gaud.) Hook. & Arn., Bot. Beech. Voy. 96. 1832; Wedd. Ann. Sc. Nat. Ser. 4, 1: 187. 1854; J. D. Hooker in Hook. f., Fl. Brit. Ind. 5: 554. 1888. *Dubrueilia peploides* Gaud. in Freyc. Voy. Bot. Uran. 495. 1830.

Flowering & fruiting: February.

Specimens examined: West Bengal: Jalpaiguri district — Chilapata, Chilapata forest range, rare in marshy ground associated with *Floscopa scandens, Ranunculus scleratus, Chenopodium album* etc., 25 Feb. 1976, *J. K. Sikdar* 4310 (CAL).

Distributional note: In India this taxon occurs in Assam, Meghalaya, Sikkim, Himachal Pradesh and in Burma, Java and Japan. Based on the scrutiny of the specimens of this taxon in CAL, it appears that this plant has been collected again from West Bengal for the first time after a lapse of 72 years.

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SOME INTERESTING ASPECTS OF THE AVIFAUNA OF THE POINT CALIMERE SANCTUARY, THANJAVUR DISTRICT, TAMIL NADU[1&2]

R. SUGATHAN[3]

The Point Calimere Sanctuary in Thanjavur District in Tamil Nadu is one of the major and important wintering grounds for migrants from the north. The Bombay Natural History Society had earlier conducted bird ringing camps in the sanctuary from 1969 to 1972. During the course of the ringing programme it was possible to obtain not only data on the status and migratory pattern of the migrant and resident species but also on some distributional peculiarities. Some stray species typical of wet evergreen forest biotope were recorded possibly while on passage to similar biotopes in Sri Lanka. Some of such typical species that were repeatedly recorded were the Threetoed Forest Kingfisher, Pied Thrush, Orangeheaded Ground Thrush, Broadtailed Grass Warbler etc. (Raju and Shekar 1971, Hussain 1976). During the course of the present study a total of 38280 birds belonging to 178 species were ringed and released between July 1980 and March 1982. The following eight species have been recorded for the first time in this area.

Lesser Flamingo **Phoeniconaias minor**

The swamps of Point Calimere Sanctuary are one of the major feeding grounds of the Large Flamingo in the southern peninsula. The birds arrive on passage either from the north or from the south (Sri Lanka). The timing of arrival and departure has been sporadic. The main influx occurs soon after the commencement of the NE monsoon (October) and the birds spread out throughout the swamp. Since the swamp lies on the flyway to Sri Lanka there is a constant movement of populations either way (northbound and southbound). No adequate data are available of the migratory movements of the flamingos in the peninsula. Very few flamingos have been trapped and ringed and there has been no recovery of any of these birds. A few stray recoveries within our limits of the flamingos ringed in Iran have been recorded from several parts of India including as far south as Point Calimere and Rameshwaram.

A number of juvenile *Phoenicopterus roseus* without any trace of pink in the plumage, were

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[1] Accepted August 1982.

[2] The Bombay Natural History Society in collaboration with the United States Fish and Wildlife Service and the Ministry of Agriculture, Government of India, is currently conducting a project entitled "Studies on the movement and population structure of Indian Avifauna" with Dr. Sálim Ali as the Principal Investigator. The project is funded from PL-480 grant No. 8851-558-01 released through the Ministry of Agriculture, Govt. of India. Two major research stations — one in the Keoladeo National Park, Rajasthan, in north India and the other in Point Calimere Sanctuary, Thanjavur District, Tamil Nadu in South India — have been established under this project and will be in operation for about five years. The data gathered will be analysed periodically and published in the journal.

[3] Bombay Natural History Society, Hornbill House, Shaheed Bhagat Singh Road, Bombay-400 023.

noticed in Point Calimere swamp from July 1980 to March 1982. They were observed feeding along with adults and later in the season, in small isolated flocks of their own. These juveniles were perhaps first year birds accompanying their parents from their breeding ground in the Rann of Kutch.

The Lesser Flamingos (*Phoeniconaias minor*) were first noticed at Point Calimere in July 1980.[4] They were observed throughout the season and also during the subsequent season. One bird was trapped and ringed in January 1982. Studies on the population fluctuation, feeding behaviour and food habits, are being carried out by the project staff.

Baza **Aviceda leuphotes leuphotes**

The genus *Aviceda* has a discontinuous distribution typical of certain forms whose peculiar distribution pattern has given rise to speculations and hypotheses on the incurssions of Malayan fauna into the peninsula. Both the species of Baza occurring in the subcontinent namely *leuphotes* and *jerdoni*, have a similar distributional pattern. They affect wet evergreen biotopes of NE Himalayas, the southern portion of the Western Ghats, and the hill zone of Sri Lanka.

A single Blackcrested Baza was trapped and ringed at Point Calimere on 24th October 1981. The bird was apparently on its way to Sri Lanka. According to the key to the subspecies in the HANDBOOK (Vol. 1) *leuphotes* differs from subspecies *syama* in having a chestnut breast band as against the all-black breast of the latter. The specimen from Point Calimere had a distinct rufous band across the chest and could well be of the nominate race. HANDBOOK (Vol. 1) speculates that the wintering populations visiting Sri Lanka could be the Himalayan form *syama*. The fact that the type locality off *leuphotes* is Pondicherry, which lies on the east coast approximately 160 km north of Point Calimere, strengthens the assumption the southern birds may belong to this subspecies.

Spoonbilled Sandpiper **Eurynorhynchus pygmaeus**

The Spoonbilled Sandpiper has been recorded as a straggler in West Bengal and Assam. There have been no other records of this species within our limits for the past fifty years.

Two birds were netted at Point Calimere Sanctuary, one on 19th February 1981 (released with Ring No. AB-86435) and the other on 19th March 1981 (preserved in BNHS collection). A third specimen was ringed and released at Chilka Lake, Orissa on 17th March 1981.

The occurrence of these birds on the east coast within the space of a month suggests that the species may be regularly wintering on our southern seaboard but has been overlooked among the dense flocks of stints with which it associates. The trappers employed by the Project when questioned, admitted that they had trapped these birds on earlier occasions before the commencement of the bird ringing programme at Point Calimere. The spatulate bill was considered by them to be that of deformed Little Stint (*Calidris minutus*)

Greyfronted/Orangebreasted Green Pigeon **Treron pompadora/Treron bicincta**

Two species of green pigeons have been recorded so far from Point Calimere. One specimen of *T. pompadora* was ringed in 1969 by the BNHS ringing camp. Subsequently 2 *pompadora* and 2 *bicincta* were ringed in April/December 1970. A single specimen of *T. bicincta* was also ringed and released on

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[4] The Lesser Flamingo was first reported from Point Calimere by R. A. S. Melluish in February 1968 (Newsletter for Birdwatchers Vol. 9(1), p. 4 January 1969).

21/12/1980. The latter species was regularly seen in Point Calimere from August to December which coincides with the fruiting of Jamun (*Syzygium cuminii*) in the area. Subspecies of *pompadora* and *bicincta* occur in the low country of Sri Lanka as well. It will be interesting to know whether there is any local migration between Indian peninsula and Sri Lanka.

Scops owl **Otus scops leggei ?**

A single specimen (♀) was netted near the forest bungalow at Point Calimere, on 16/12/1981. The specimen has been preserved in the BNHS collection. It has a smaller tarsus (21 mm) and is darker than three specimens of *sunia* in BNHS collection. It appears thus to be *leggei* of Sri Lanka.

Indian Cliff Swallow **Hirundo fluvicola**

A single specimen (♂) netted on 18/10/1980 and preserved in BNHS collection. The previous southernmost record for this species is Coimbatore at the foot of the Nilgiris and the present record in a way confirms the sight record by Phillips in Sri Lanka (*JBNHS* 47: 740).

Blue Chat **Erithacus brunneus**

This species breeds in higher hills of the Himalayan ranges and winters in the hill zones of South India and Sri Lanka, preferring evergreen biotopes. It is interesting to note that it has not been recorded in the plains of the peninsula or anywhere[5] between the breeding and wintering ranges. Seven Blue Chats were ringed at Point Calimere in October 1969. Eighteen individuals (♂ ♀) were ringed between October-November, 1980. Again five were ringed during the same period in 1981, indicating that Point Calimere is a regular stage for Blue Chats on their winter migration. Birds were regularly noted during this period. However, none were recorded on spring migration, suggesting that these birds may be using a different route (Western Ghats?) on their return migration.[6]

Forest Wagtail **Motacilla indica**

Another species seen on passage in Point Calimere. The first winter arrivals were noted on census paths within the sanctuary on 15th September 1980, and thereafter they were regularly seen until third week of January 1981. Peak influx was noticed in October-November. Six birds were netted and ringed during this period. Once again no birds were seen in spring migration suggesting that this species also takes a different route on return migration.

Rosefinch **Carpodacus erythrinus**

This species has been recorded as wintering in the Indian peninsula but so far has not been recorded in Sri Lanka. A single female, (in BNHS collection) was obtained at Point Calimere on 24-1-1981.

Several species of birds have been recorded from Point Calimere Sanctuary during the course of our studies. A checklist of the birds ringed/recorded is given in the appendix. Of the birds recorded so far the Spoonbilled Sandpiper, hitherto regarded as a rare straggler, may actually prove to be a regular winter visitor to the area. Evidence is now available that the Lesser Flamingo occurs on the eastern seaboard from Chilka in the north to Point Calimere and possibly Rameswaram and Sri Lanka in the south. Both large and lesser Flamingos occur in the same areas, but their feeding ecology needs to be studied. The occurrence of Baza, together with that of Blue Chat, Broad-tailed Grass Warbler, Threetoed Forest Kingfisher and Scops Owl, is intriguing.

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[5] Recorded at Bhimashankar, Western Ghats — SA.

[6] Probably Point Calimere birds come down the Western Ghats. The species is quite common seasonably in sholes in the Nilgiris, e.g. Coonoor-SA.

CHECKLIST OF THE BIRDS OF POINT CALIMERE

B = Breeding, C = Common, R = Resident, M = Migrant, SM = Seasonal Migrant, Ra = Rare, O = Occasional.

Common Name	Species	Status
1. Little Grebe	*Podiceps ruficollis*	SM, B
2. Grey or Spottedbilled Pelican	*Pelecanus philippensis*	SM
3. Cormorant	*Phalacrocorax carbo*	O
4. Indian Shag	*Phalacrocorax fuscicollis*	O
5. Little or Pygmy Cormorant	*Phalacrocorax niger*	O
6. Darter	*Anhinga rufa*	O
7. Grey Heron	*Ardea cinerea*	SM
8. Purple Heron	*Ardea purpurea*	SM
9. Little Green Heron	*Butorides striatus*	O
10. Pond Heron	*Ardeola grayii*	C
11. Cattle Egret	*Bubulcus ibis*	C
12. Large Egret	*Ardea alba*	C
13. Smaller Egret	*Egretta intermedia*	C
14. Little Egret	*Egretta garzetta*	C
15. Indian Reef Heron	*Egretta gularis*	C
16. Night Heron	*Nycticorax nycticorax*	SM
17. Black Bittern	*Ixobrychus flavicollis*	Ra
18. Painted Stork	*Ibis leucocephalus*	C
19. Openbill Stork	*Anastomus oscitans*	SM
20. Whitenecked Stork	*Ciconia episcopus*	SM
21. Blacknecked Stork	*Ephippiorhynchus asiaticus*	SM
22. White Ibis	*Threskiornis melanocephala*	SM
23. Spoonbill	*Platalea leucorodia*	SM
24. Flamingo	*Phoenicopterus roseus*	SM
25. Lesser Flamingo	*Phoeniconaias minor*	SM
26. Barheaded Goose	*Anser indicus*	Ra
27. Pintail	*Anas acuta*	M
28. Common Teal	*Anas crecca*	M
29. Spotbill Duck	*Anas poecilorhyncha*	SM
30. Mallard	*Anas platyrhynchos*	Ra
31. Gadwall	*Anas strepera*	M
32. Garganey	*Anas querquedula*	M
33. Shoveller	*Anas clypeata*	M
34. Cotton teal	*Nettapus coromandelianus*	SM
35. Blackwinged Kite	*Elanus caeruleus*	O
36. Indian Blackcrested Baza	*Aviceda leuphotes*	R
37. Pariah or Black Kite	*Milvus migrans*	O
38. Brahminy Kite	*Haliastur indus*	C,B
39. Shikra	*Accipiter badius*	SM
40. Sparrow-Hawk	*Accipiter nisus*	M
41. Besra Sparrow-Hawk	*Accipiter virgatus*	M
42. White-eyed Buzzard-Eagle	*Butastur teesa*	O

Common Name	Species	Status
43. Booted Hawk-Eagle	*Hieraatus pennatus*	O
44. Tawny Eagle	*Aquila rapax*	O
45. White-bellied Sea Eagle	*Haliaeetus leucogaster*	O
46. Egyptian or Scavenger Vulture	*Neophron percnopterus*	O
47. Pale Harrier	*Circus macrourus*	M
48. Montagu's Harrier	*Circus pygargus*	M
49. Pied Harrier	*Circus melanoleucos*	M
50. Marsh Harrier	*Circus aeruginosus*	M
51. Short-toed Eagle	*Circaetus gallicus*	O
52. Crested Serpent Eagle	*Spilornis cheela*	O
53. Osprey	*Pandion haliaetus*	M
54. Peregrine Falcon	*Falco peregrinus*	M
55. Redheaded Merlin	*Falco chicquera*	M
56. Kestrel	*Falco tinnunculus*	SM
57. Grey Partridge	*Francolinus pondicerianus*	C,R
58. Jungle Bush Quail	*Perdicula asiatica*	C,R
59. Common Bustard-Quail	*Turnix suscitator*	C,R
60. Bluebreasted Banded Rail	*Rallus striatus*	M
61. Banded Crake	*Rallina eurizonoides*	SM
62. Whitebreasted Waterhen	*Amaurornis phoenicurus*	C,R
63. Water Cock, Kora	*Gallicrex cinerea*	SM
64. Moorhen	*Gallinula chloropus*	SM
65. Bronzewinged Jacana	*Metopidius indicus*	SM
66. Oystercatcher	*Haematopus ostralegus*	M
67. Blackwinged Stilt	*Himantopus himantopus*	SM
68. Avocet	*Recurvirostra avosetta*	M
69. Crab Plover	*Dromas ardeola*	SM
70. Stone Curlew	*Burhinus oedicnemus*	SM
71. Great-Stone Plover	*Esacus magnirostris*	SM,B
72. Collared Pratincole	*Glareola pratincola*	SM
73. Small Indian Pratincole	*Glareola lactea*	O
74. Redwattled Lapwing	*Vanellus indicus*	C,R
75. Yellow-wattled Lapwing	*Vanellus malabaricus*	C,R
76. Grey Plover	*Pluvialis squatarola*	M,C
77. Eastern Golden Plover	*Pluvialis dominica*	M,C
78. Large Sand Plover	*Charadrius leschenaultii*	M
79. Little Ringed Plover	*Charadrius dubius*	C,R
80. Ringed Plover	*Charadrius hiaticula*	O
81. Kentish Plover	*Charadrius alexandrinus*	C,R
82. Lesser Sand Plover	*Charadrius mongolus*	M,C
83. Whimbrel	*Numenius phaeopus*	M,C
84. Curlew	*Numenius arquata*	M,C
85. Blacktailed Godwit	*Limosa limosa*	M,C
86. Bartailed Godwit	*Limosa lapponica*	M,C
87. Spotted or Dusky Redshank	*Tringa erythropus*	M
88. Common Redshank	*Tringa totanus*	M,C
89. Marsh Sandpiper	*Tringa stagnatilis*	M,C

Common Name	Species	Status
90. Greenshank	*Tringa nebularia*	M,C
91. Green Sandpiper	*Tringa ochropus*	M,C
92. Wood Sandpiper	*Tringa glareola*	M,C
93. Terek Sandpiper	*Tringa terek*	M,O
94. Common Sandpiper	*Tringa hypoleucos*	M,C
95. Turnstone	*Arenaria interpres*	M,C
96. Snipebilled Godwit	*Limnodromus semipalmatus*	M.O
97. Pintail Snipe	*Gallinago stenura*	M,O
98. Swinhoe's Snipe	*Gallinago megala*	M,O
99. Fantail Snipe	*Gallinago gallinago*	M,O
100. Knot	*Calidris canutus*	M,O
101. Eastern Knot	*Calidris tenuirostris*	M,O
102. Sanderling	*Calidris alba*	M,O
103. Little Stint	*Calidris minutus*	M,C
104. Temminck's Stint	*Calidris temminckii*	M,O
105. Longtoed Stint	*Calidris subminutus*	M,O
106. Dunlin	*Calidris alpinus*	M,C
107. Curlew-Sandpiper	*Calidris testaceus*	M,C
108. Spoonbilled Sandpiper	*Eurynorhynchus pygmaeus*	M,Ra
109. Broadbilled Sandpiper	*Limicola falcinellus*	M,C
110. Ruff and Reeve	*Philomachus pugnax*	M,C
111. Rednecked Phalarope	*Phalaropus lobatus*	M,O
112. Herring Gull	*Larus argentatus*	M,C
113. Lesser Blackbacked Gull	*Larus fuscus*	M,C
114. Great Blackheaded Gull	*Larus ichthyaetus*	M,C
115. Brownheaded Gull	*Larus brunnicephalus*	M,C
116. Blackheaded Gull	*Larus ridibundus*	M,C
117. Whiskered Tern	*Chlidonias hybrida*	M,C
118. Whitewinged Black Tern	*Chlidonias leucopterus*	M,C
119. Gullbilled Tern	*Gelochelidon nilotica*	M,C
120. Caspian Tern	*Hydroprogne caspia*	M,C
121. Roseate or Rosy Tern	*Sterna dougalli*	M,O
122. Common Tern	*Sterna hirundo*	M,C
123. Sooty Tern	*Sterna fuscata*	M,O
124. Little Tern	*Sterna albifrons*	R,B
125. Large Crested Tern	*Sterna bergii*	M,O
126. Indian Lesser Crested Tern	*Sterna bengalensis*	M,O
127. Indian River Tern	*Sterna aurantia*	M,O
128. Pompadour or Greyfronted green pigeon	*Treron pompadora*	S,M
129. Orangebreasted Green pigeon	*Treron bicincta*	S,M
130. Blue Rock Pigeon	*Columba livia*	C
131. Indian Ring Dove	*Streptopelia decaocto*	R,B
132. Spotted Dove	*Streptopelia chinensis*	R.B
133. Roseringed Parakeet	*Psittacula krameri*	C,SM
134. Redwinged Crested Cuckoo	*Clamator coromandus*	M
135. Pied Crested Cuckoo	*Clamator jacobinus*	SM,B
136. Large Hawk-Cuckoo	*Cuculus sparverioides*	SM

Common Name	Species	Status
137. Small Cuckoo	*Cuculus poliocephalus*	SM
138. Common Hawk-Cuckoo or Brain fever Bird	*Cuculus varius*	SM
139. Indian Cuckoo	*Cuculus micropterus*	SM
140. Indian Plaintive Cuckoo	*Cacomantis merulinus*	SM
141. Indian Banded Bay Cuckoo	*Cacomantis sonneratii*	SM
142. Koel	*Eudynamys scolopacea*	C,SM
143. Small Greenbilled Malkoha	*Rhopodytes viridirostris*	C,R
144. Crow-Pheasant or Coucal	*Centropus sinensis*	C,R
145. Barn Owl	*Tyto alba*	O
146. Eagle Owl, Great Horned Owl	*Bubo bubo*	O
147. Scops Owl	*Otus scops*	Ra
148. Spotted Owlet	*Athene brama*	C,R
149. Shorteared Owl	*Asio flammeus*	M,O
150. Indian Jungle Nightjar	*Caprimulgus indicus*	M,O
151. European Nightjar	*Caprimulgus europaeus*	Ra
152. Longtailed Nightjar	*Caprimulgus macrurus*	?
153. Common Indian Nightjar	*Caprimulgus asiaticus*	?
154. Palm Swift	*Cypsiurus parvus*	C,R
155. Lesser Pied Kingfisher	*Ceryle rudis*	SM
156. Common Kingfisher	*Alcedo atthis*	C,SM
157. Threetoed Kingfisher	*Ceyx erithacus*	SM
158. Whitebreasted Kingfisher	*Halcyon smyrnensis*	C,R
159. Blackcapped Kingfisher	*Halcyon pileata*	SM
160. Chestnut-headed Bee-eater	*Merops leschenaulti*	SM
161. Bluetailed Bee-eater	*Merops philippinus*	SM
162. Green Bee-eater	*Merops orientalis*	R,C
163. Indian Roller or Blue Jay	*Coracias benghalensis*	C,R
164. Hoopoe, Hudhud	*Upupa epops*	SM
165. Wryneck	*Jynx torquilla*	O
166. Lesser Goldenbacked Woodpecker	*Dinopium benghalense*	C,R
167. Indian Pitta	*Pitta brachyura*	SM
168. Bush Lark	*Mirafra assamica*	SM
169. Redwinged Bush Lark	*Mirafra erythroptera*	SM
170. Ashycrowned Finch-Lark	*Eremopterix grisea*	SM
171. Sand Lark	*Calandrella raytal*	?
172. Crested Lark	*Galerida cristata*	SM
173. Eastern Skylark	*Alauda gulgula*	R,C
174. Collared Sand Martin	*Riparia riparia*	O
175. Swallow	*Hirundo rustica*	M
176. Indian Cliff Swallow	*Hirundo fluvicola*	M,O
177. Baybacked Shrike	*Lanius vittatus*	SM
178. Brown Shrike	*Lanius cristatus*	C,R
179. Golden Oriole	*Oriolus oriolus*	C,R
180. Black Drongo or King Crow	*Dicrurus adsimilis*	C,R
181. Grey or Ashy Drongo	*Dicrurus leucophaeus*	SM
182. Whitebellied Drongo	*Dicrurus caerulescens*	SM
183. Ashy Swallow-Shrike	*Artamus fuscus*	C,R

Common Name	Species	Status
184. Greyheaded Myna	*Sturnus malabaricus*	SM
185. Blackheaded or Brahminy Myna	*Sturnus pagodarum*	SM
186. Rosy Pastor	*Sturnus roseus*	SM
187. Common Myna	*Acridotheres tristis*	C,R
188. Indian Tree Pie	*Dendrocitta vagabunda*	C,SM
189. House Crow	*Corvus splendens*	C,R
190. Jungle Crow	*Corvus macrorhynchos*	C,R
191. Common Wood Shrike	*Tephrodornis pondicerianus*	C,R
192. Blackheaded Cuckoo-Shrike	*Coracina melanoptera*	C,R
193. Common Iora	*Aegithina tiphia*	C,R
194. Redvented Bulbul	*Pycnonotus cafer*	C,R
195. Whitebrowed Bulbul	*Pycnonotus luteolus*	C,R
196. Jungle Babbler	*Turdoides striatus*	C,R
197. Brown Flycatcher	*Muscicapa latirostris*	M
198. Brownbreasted Flycatcher	*Muscicapa muttui*	M
199. Redbreasted Flycatcher	*Muscicapa parva*	M
200. Bluethroated Flycatcher	*Muscicapa rubeculoides*	M
201. Paradise Flycatcher	*Terpsiphone paradisi*	M
202. Blacknaped Flycatcher	*Monarcha azurea*	SM
203. Tailor Bird	*Orthotomus sutorius*	C,R
204. Thickbilled Warbler	*Phragmaticola aedon*	M
205. Broadtailed Grass Warbler	*Schoenicola platyura*	Ra
206. Blyth's Reed Warbler	*Acrocephalus dumetorum*	M
207. Paddyfield Warbler	*Acrocephalus agricola*	M
208. Booted Warbler	*Hippolais caligata*	M
209. Lesser Whitethroat	*Sylvia curruca*	M
210. Largebilled Leaf Warbler	*Phylloscopus magnirostris*	M
211. Dull Green Leaf Warbler	*Phylloscopus trochiloides*	M
212. Blue Chat	*Erithacus brunneus*	M
213. Magpie-Robin	*Copsychus saularis*	C,R
214. Indian Robin	*Saxicoloides fulicata*	C,R
215. Pied Ground Thrush	*Zoothera wardii*	M
216. Orangeheaded Ground Thrush	*Zoothera citrina cyanotus*	M
217. Pipit	*Anthus* sp.	M
218. Paddyfield Pipit	*Anthus novaeseelandiae*	M
219. Forest Wagtail	*Motacilla indica*	M
220. Yellow Wagtail	*Motacilla flava*	M
221. Grey Wagtail	*Motacilla caspica*	M
222. Pied or White Wagtail	*Motacilla alba*	M
223. Large Pied Wagtail	*Motacilla maderaspatensis*	C,B
224. Tickell's Flowerpecker	*Dicaeum erythrorhynchos*	C,R
225. Purplerumped Sunbird	*Nectarinia zeylonica*	SM,B
226. Loten's Sunbird	*Nectarinia lotenia*	O
227. Purple Sunbird	*Nectarinia asiatica*	SM,B
228. House Sparrow	*Passer domesticus*	C,R
229. Yellow throated Sparrow	*Petronia xanthocollis*	SM
230. Baya	*Ploceus philippinus*	SM
231. Blackheaded Munia	*Lonchura malacca*	SM
232. Common Silverbill	*Lonchura malabarica*	SM
233. Common Rosefinch	*Carpodacus erythrinus*	M

It has been postulated (Meher-Homji 1974, a & b) that the climatic conditions in the Coromandel Coast in the peninsula was humid with equatorial climate not unlike that of S. W. part of Sri Lanka in the recent past, suggesting the occurrence of a contiguous ecosystem between Indian Peninsula and Sri Lanka. The occurrence and pattern of movements of several species of birds typical of wet evergreen biotopes in the Point Calimere scrub, seems to support the above theory.

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TAXONOMIC SIGNIFICANCE OF OVIPOSITOR IN SOME INDIAN GRASSHOPPERS (ORTHOPTERA: ACRIDIDAE)[1]

M. Kamil Usmani and S. Adam Shafee[2]

(With two plates and a text-figure)

Comparative study of ovipositor is made in thirty Indian species representing twenty-eight genera of the family Acrididae. Its taxonomic significance is shown. Shape of dorsal and ventral valves, length of dorsal valve and lateral apodeme are suggested as characters of taxonomic significance.

INTRODUCTION

The ovipositor is an organ for the process of deposition of eggs. It consists of three pairs of valves. Slifer (1939), Agarwala (1951) and Uvarov (1966) named first and third valves of ovipositor as ventral and dorsal valves respectively. Qadri (1940) named them as anterior and lateral valves. The second valve was named as upper egg-guide by Slifer (1939), posterior valve by Qadri (1940), mesial valve by Agarwala (1951) and inner valve by Uvarov (1966). The present writers followed Agarwala (1951) in adopting the names, ventral, mesial and dorsal valves for first, second and third valves of ovipositor respectively (fig. 1). Agarwala (1953) made a comparative study of ovipositor in various species of Acrididae and correlated the morphology of ovipositor with the nature of the oviposition sites. Mishchenko (1952) and Willemse (1967, 1968, 1975, 1977) gave brief descriptions and illustrations of ovipositor in some species of Acrididae.

Keeping in view the taxonomic importance of ovipositor, the present writers made an attempt to make a comparative study of ovipositor in thirty Indian species representing twenty-eight genera of the family Acrididae. The characters i.e. shape of dorsal and ventral valves, length of dorsal valve and lateral apodeme of ovipositor are suggested as characters of taxonomic significance.

Descriptions of ovipositor:

1. **Pyrgomorpha conica** (Olivier) (Pl. 1, fig. A).—Dorsal valve moderately broad, slightly more than three times as long as wide, distinctly shorter than lateral apodeme, dorsal condyle prominent; ventral valve with apical tip pointed, basal sclerite well developed, setose.

2. **Atractomorpha crenulata** (Fabricius) (Pl. 1, fig. B).—Dorsal valve moderately broad, four times as long as wide, slightly longer than lateral apodeme, dorsal condyle much prominent; ventral valve with slope deeply concave, basal sclerite narrow; mesial valve and apical tip long and pointed.

3. **Chrotogonus trachypterus** (Blanchard) (Pl. 1, fig. C).—Dorsal valve broad, two and a half times as long as wide, as long as lateral apodeme, dorsal edge tuberculate, dorsal condyle not prominent; ventral valve with apical tip pointed, basal sclerite narrow,

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setose on apical half; mesial valve almost triangular.

4. **Aularches scabiosae** (Fabricius) (Pl. 1, fig. D).—Dorsal valve moderately broad, slightly more than three times as long as wide, longer than lateral apodeme, apical tip curved and pointed, dorsal edge tuberculate, dorsal condyle not prominent; ventral valve with slope deeply concave, basal sclerite narrow and tuberculate.

5. **Poekilocerus pictus** (Fabricius) (Pl. 1, fig. E).—Dorsal valve broad, less than two and a half times as long as wide, much shorter than lateral apodeme, apical tip small and pointed, dorsal edge with irregular ridges, dorsal condyle less prominent; ventral valve with slope deeply concave, basal sclerite narrow and smooth.

6. **Orthacris ceylonica** (Kirby) (Pl. 1, fig. F). —Dorsal valve more or less of uniform width, five times as long as wide, longer than lateral apodeme, apical tip blunt, dorsal condyle much prominent; ventral valve with apical tip blunt, lateral tooth distinct, basal sclerite narrow, serrated apically; mesial valve with apical tip small and pointed.

7. **Hieroglyphus banian** (Fabricius) (Pl. 1, fig. G).—Dorsal valve moderately broad, three and a half times as long as wide, slightly shorter than lateral apodeme, dorsal condyle prominent; ventral valve with slope deeply concave, lateral tooth well developed, lateral and basal sclerites serrated basally; mesial valve dilated apically.

8. **Spathosternum prasiniferum** (Walker) (Pl. 1, fig. H).—Dorsal valve moderately broad, slightly more than three times as long as wide, as long as lateral apodeme, dorsal condyle much prominent; ventral valve with slope deeply concave, lateral tooth absent, lateral and basal sclerites smooth; mesial valve blunt apically.

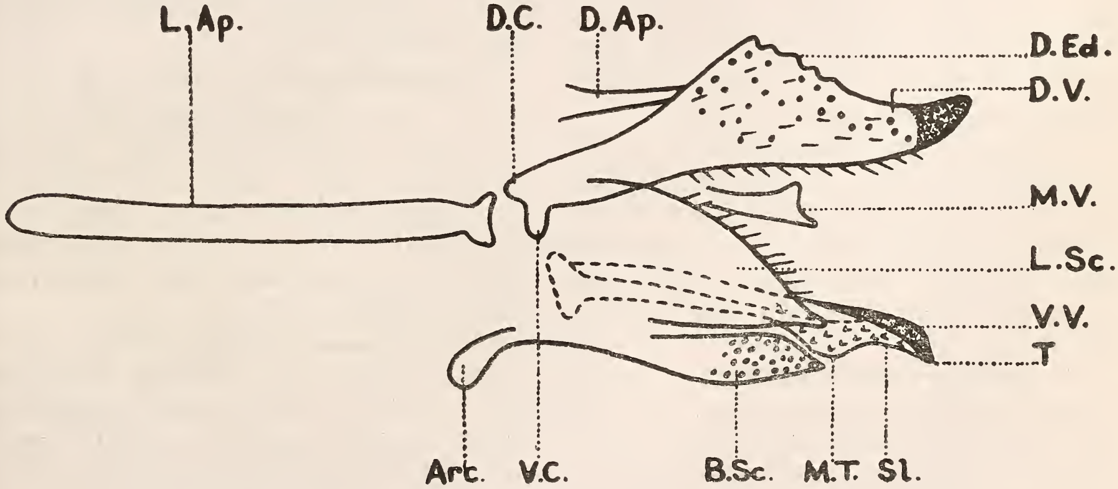


Fig. 1. Ovipositor in lateral view.

Abbreviations: Arc.-Arcus; B.Sc. — Basal sclerite; D.Ap. — Dorsal apodeme; D.C. — Dorsal condyle; D.Ed. — Dorsal edge; D.V. — Dorsal valve; L.Ap. — Lateral apodeme; L. Sc. — Lateral sclerite; M.T. — Mesial tooth; M.V. — Mesial valve; Sl. — Slope; T. — Tip; V.C. — Ventral condyle; V.V. — Ventral valve.

9. **Oxya hyla** Serville (Pl. 1, fig. I).—Dorsal valve long and narrow, five and a half times as long as wide, longer than lateral apodeme, dorsal edge with acute spines; ventral valve long, lower margin with acute spines, basal sclerite narrow and serrated; mesial valve long and pointed.

10. **Oxya velox** (Fabricius) (Pl. 1, fig. J).—Dorsal valve long and narrow, six and a half times as long as wide, longer than lateral apodeme, dorsal edge with small blunt spines; ventral valve long, lower margin with small blunt spines, basal sclerite narrow and smooth; mesial valve long and pointed.

11. **Choroedocus robustus** (Serville) (Pl. 1, fig. K).—Dorsal valve broad, slightly less than three times as long as wide, much shorter than lateral apodeme; ventral valve with slope slightly cancave, basal sclerite tuberculate at apical half; mesial valve dilated apically.

12. **Eyprepocnemis alacris** (Serville) (Pl. 1, fig. L).—Dorsal valve moderately broad, more than three times as long as wide, as long as lateral apodeme; ventral valve with slope broadly concave, basal sclerite punctate; mesial valve slightly dilated apically.

13. **Acrida turrita** (Linnaeus) (Pl. 1, fig. M).—Dorsal valve broad, two and a half times as long as wide, much shorter than lateral apodeme, apical tip short; ventral valve with apical tip short, basal sclerite narrow and tuberculate; mesial valve with apical tip short and blunt.

14. **Acrida exaltata** (Walker) (Pl. 1, fig. N).—Dorsal valve broad, slightly more than three times as long as wide, shorter than lateral apodeme; ventral valve with apical tip short, basal sclerite narrow and tuberculate; mesial valve slightly dilated apically.

15. **Ceracris nigricornis** Walker (Pl. 1, fig. O).—Dorsal valve narrow, four times as long as wide, shorter than lateral apodeme, apical tip blunt; ventral valve with apical tip long and pointed, slope deeply concave, basal sclerite narrow.

16. **Phlaeoba infumata** Brunner (Pl. 1, fig. P).—Dorsal valve narrow, slightly more than four times as long as wide, shorter than lateral apodeme; ventral valve with apical tip long and pointed, slope deeply cancave, mesial tooth truncated, basal sclerite setose on apical half; mesial valve blunt.

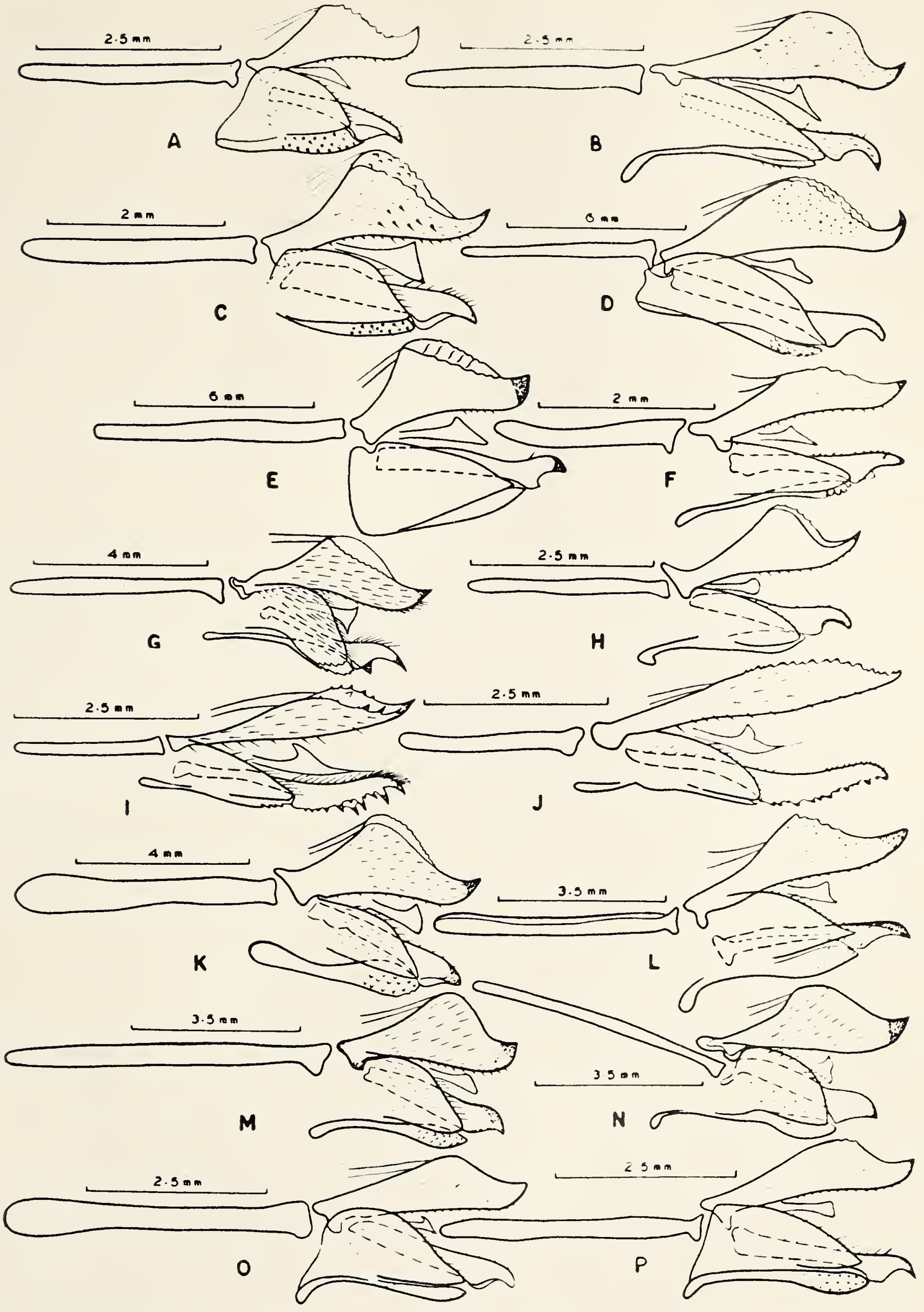
17. **Xenocatantops humilis** (Serville) (Pl. 2, fig. A).—Dorsal valve narrow, more than three times as long as wide, shorter than lateral apodeme, apical tip blunt; ventral valve with apical tip long and pointed, slope deeply concave, basal sclerite narrow and smooth; mesial valve dilated apically.

18. **Eucoptacra praemorsa** (Stal) (Pl. 2, fig. B).—Dorsal valve narrow, more than four times as long as wide, much longer than lateral apodeme, apical tip long and blunt, dorsal condyle prominent; ventral valve with apical tip long and pointed, slope deeply concave, basal sclerite narrow.

19. **Orthacanthacris** sp. (Pl. 2, fig. C).—Dorsal valve moderately broad, three and a half times as long as wide, shorter than literal apodeme, apical tip long and blunt, dorsal condyle much prominent; ventral valve with apical tip blunt, slope concave, basal sclerite narrow and tuberculate; mesial valve dilated apically.

20. **Brachyxenia scutifera** (Walker) (Pl. 2, fig. D).—Dorsal valve moderately broad, less than four times as long as wide, longer than lateral apodeme, apical tip blunt; ventral valve with apical tip acute, basal sclerite punctate.

21. **Caloptenopsis glaucopsis** (Walker) (Pl. 2, fig. E).—Dorsal valve moderately broad, more than three times as long as wide, as long as lateral apodeme, apical tip blunt;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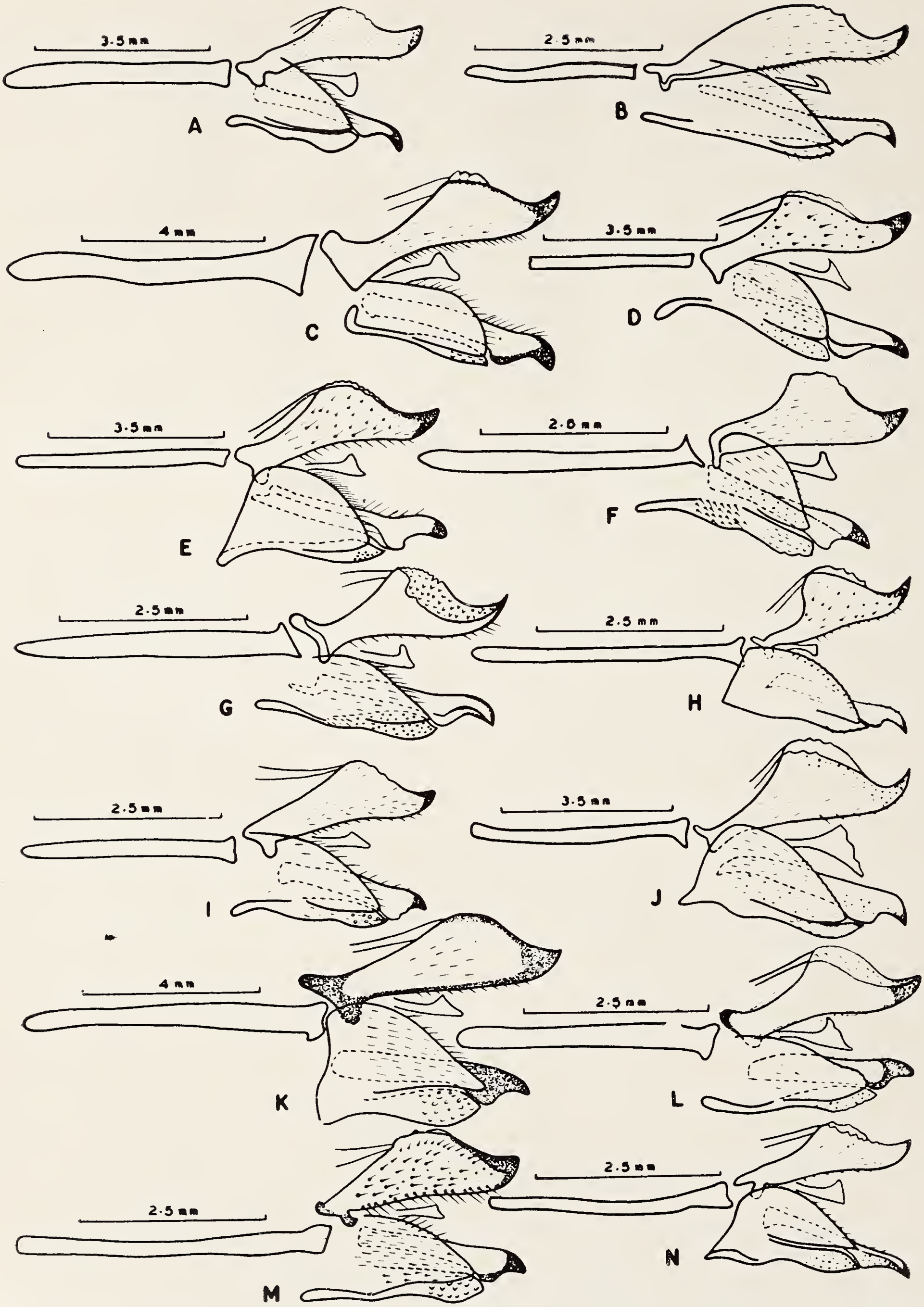
Figs. A-P. Ovipositor in lateral view: (A) *Pyrgomorpha conica* (Olivier); (B) *Atarctomorpha crenulata* (Fabricius); (C) *Chrotogonus trachypterus* (Blanchard); (D) *Aularches scabiosae* (Fabricius); (E) *Poekilocerus pictus* (Fabricius); (F) *Orthacris ceylonica* (Kirby); (G) *Hieroglyphus banian* (Fabricius); (H) *Spathosternum prasiniferum* (Walker); (I) *Oxya hyla* Serville; (J) *Oxya velox* (Fabricius); (K) *Choroedocus robustus* (Serville); (L) *Eyprepocnemis alacris* (Serville); (M) *Acrida turrita* (Linnaeus); (N) *Acrida exaltata* (Walker); (O) *Ceracris nigricornis* Walker; (P) *Phlaeoba infumata* Brunner.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Figs. A-N. Ovipositor in lateral view: (A) *Xenocatantops humilis* (Serville); (B) *Eucoptacra praemorsa* (Stal); (C) *Orthacanthacris* sp.; (D) *Brachyxenia scutifera* (Walker); (E) *Caloptenopsis glaucopsis* (Walker); (F) *Oedaleus abruptus* (Thunberg); (G) *Aiolopus affinis* (Bolivar); (H) *Acrotylus humbertianus* Saussure; (I) *Trilophidia annulata* (Thunberg); (J) *Gastrimargus transversus* (Thunberg); (K) *Locusta migratoria* (Linnaeus); (L) *Morphacris citrina* Kirby; (M) *Dociostaurus decisus* (Walker); (N) *Stauroderus bicolor* (Charpentier).

ventral valve with apical tip blunt, slope concave.

22. **Oedaleus abruptus** (Thunberg) (Pl. 2, fig. F).—Dorsal valve broad, slightly less than three times as long as wide, shorter than lateral apodeme, apical tip blunt, dorsal condyle not prominent; ventral valve with slope slightly concave, basal sclerite tuberculate; mesial valve with apical tip blunt.

23. **Aiolopus affinis** (Bolivar) (Pl. 2, fig. G).—Dorsal valve moderately broad, more than three times as long as wide, shorter than lateral apodeme, apical tip long and much acute, dorsal condyle much prominent; ventral valve with apical tip long, curved and pointed, basal sclerite punctuate.

24. **Acrotylus humbertianus** Saussure (Pl. 2, fig. H).—Dorsal valve broad, less than three times as long as wide, much shorter than lateral apodeme, apical tip long and acute, dorsal condyle much prominent; ventral valve with slope deeply concave, basal sclerite narrow, setose apically; mesial valve with apical tip short.

25. **Trilophidia annulata** (Thunberg) (Pl. 2, fig. I).—Dorsal valve moderately broad, slightly more than three times as long as wide, slightly shorter than lateral apodeme, apical tip short and blunt, dorsal condyle not much prominent; ventral valve with apical tip short and blunt, basal sclerite well developed, tuberculate apically; mesial valve with apical tip of medium size.

26. **Gastrimargus transversus** (Thunberg) (Pl. 2, fig. J).—Dorsal valve broad, less than three times as long as wide, as long as lateral apodeme, apical tip long and pointed, dorsal condyle prominent; ventral valve with slope deeply concave, mesial tooth broadly truncated, basal sclerite tuberculate; mesial valve much dilated apically.

27. **Locusta migratoria** (Linnaeus) (Pl. 2, fig. K).—Dorsal valve uniformly broad, three and a half times as long as wide, shorter than lateral apodeme, apical tip short and acute, dorsal condyle blunt, much prominent; ventral valve with slope slightly concave, basal sclerite broad and tuberculate.

28. **Morphacris citrina** Kirby (Pl. 2, fig. L).—Dorsal valve moderately broad, three times as long as wide, shorter than lateral apodeme, apical tip blunt, dorsal edge with small tubercles, dorsal condyle blunt and much prominent; ventral valve with slope slightly concave, basal sclerite serrated; mesial valve dilated apically.

29. **Dociostaurus decisus** (Walker) (Pl. 2, fig. M).—Dorsal valve broad, three times as long as wide, shorter than lateral apodeme, apical tip short and blunt; ventral valve with apical tip short, mesial tooth well developed.

30. **Stauroderus bicolor** (Charpentier) (Pl. 2, fig. N).—Dorsal valve narrow, more than three times as long as wide, shorter than lateral apodeme; ventral valve with apical tip long and pointed, slope tuberculate, not much curved, basal sclerite broad and tuberculate; mesial valve dilated apically.

DISCUSSION

Comparative study of ovipositor in thirty species of Acrididae revealed that there are certain characters i.e. length of lateral apodeme and shape of ovipositor valves have significant value in separating various genera of the family Acrididae. Dorsal valve broad and shorter than lateral apodeme in *Pyrgomorpha, Poekilocerus, Hieroglyphus, Choroedocus, Acrida, Orthacanthacris, Oedaleus, Aiolopus, Acrotylus, Trilophidia, Locusta, Morphacris* and *Dociostaurus;* dorsal valve narrow and shorter than lateral apodeme in *Ceracris, Phlaeoba, Xenocatantops* and *Stauroderus;*

dorsal valve broad and longer than lateral apodeme in *Atractomorpha, Aularches* and *Brachyxenia;* dorsal valve narrow and longer than lateral apodeme in *Orthacris, Oxya* and *Eucoptacra;* dorsal valve broad and as long as lateral apodeme in *Chrotogonus, Spathosternum, Eyprepocnemis, Caloptenopsis* and *Gastrimargus.*

ACKNOWLEDGEMENTS

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THE BIRDS OF RANGANATHITTU[1]

S. G. Neginhal[2]

(*With two plates*)

INTRODUCTION

Ranganathittu Bird Sanctuary, near Mysore, is a well-known heronry of south India where fourteen species breed from May to November on the islets of the Kaveri river. These are: Openbill stork (*Anastomus oscitans*), Eastern Large Egret (*Egretta alba*), Smaller or Median Egret (*Egretta intermedia*), Little Egret (*Egretta garzetta*), Cattle Egret (*Bubulcus ibis*), White Ibis (*Threskiornis melanocephala*), Spoonbill (*Platalea leucorodia*), Darter or Snake-bird (*Anhinga rufa*), Large Cormorant (*Phalacrocorax carbo*), Indian Shag (*Phalacrocorax fuscicollis*), Little Cormorant (*Phalacrocorax niger*), Night Heron (*Nycticorax nycticorax*), Indian Pond Heron or Paddy bird (*Ardeola grayii*), and Eastern Purple Heron (*Ardea purpurea*).

From November onwards other birds like the Great Stone Plover (*Esacus magnirostris*), the Indian River Tern (*Sterna aurantia*), the Indian Cliff Swallow (*Hirundo fluvicola*) and the Streaked Weaver Bird (*Ploceus manyar*) breed. In addition the Lesser Whistling Teal (*Dendrocygna javanica*), the Pied Kingfisher (*Ceryle rudis*), the Whitenecked Stork (*Ciconia episcopus*), the Large Pied Wagtail (*Motacilla maderaspatensis*), the Osprey (*Pandion haliaetus*), and the Redwattled Lapwing (*Vanellus indicus*) and a variety of other birds are also seen, some throughout the year, on the vegetation growing along the banks of the river.

History. At Ranganathittu there is an ancient weir across the Kaveri river to impound the waters and convey through an aqueduct to Srirangapatna, a historical and ancient island-town nearby. The weir and the aqueduct were constructed between 1645-1648 A.D. during the reign of Sri Kanthirava Narasaraj, a king of Mysore, to perpetuate the name of his favourite consort "Doddajamma". The weir impounded water to form a large and deep reservoir and has a number of islets. When exactly the birds started breeding here is of course not recorded.

The islets were legally constituted as a bird sanctuary in 1940 at the suggestion of Sálim Ali, during his survey of the birds of Mysore.

Nesting vegetation. There are 5-6 small islets in the impounded waters of the Kaveri river. These islets are insulated by deep waters 20-30 ft deep and bear some riverine vegetation, on which the birds nest. The main nesting trees are *Terminalia arjuna, Pongamia glabra, Salix* sp., *Vitex* sp., *Ficus* sp., *Pandanus* and *Caesalpinia bonducella* tangles and rushes; and even sedges form the nesting vegetation at Ranganathittu.

The sanctuary is surrounded by irrigated agricultural lands, which provide the feeding grounds for the nesting birds.

Arrival and Breeding. The arrival timings of the nesting birds at Ranganathittu varies from

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year to year. Naturally the birds do not settle down to breed unless the food is assured to them, which at Ranganathittu, depends upon the release of the K.R.S. Dam waters by which the agricultural fields are flooded and prepared for planting the paddy seedlings. The commencement of the rainy season, after a long dry spell of the summer, decides the commencement of the breeding season of the heronry birds. Even then the arrival and breeding timings of the various species of the birds are not the same. Some birds like the Openbill Storks arrive earlier in the breeding season and some like the Spoonbills come later. The Table gives the arrival timings of some of the birds that breed at this Sanctuary.

Predation. Crows (both *Corvus macrorhynchos* and *C. splendens*) cause heavy damage to the eggs and nestlings of the breeding birds. At Ranganathittu boats and coracles take visitors around the islets for seeing the heronry. When the boats and coracles go very near, the breeding birds get frightened and fly away leaving their nests unprotected. The crows anticipating this situation follow the boats and pillage the eggs and even take away the nestlings from the unguarded nests.

The Brahminy Kite (*Haliastur indus*) is also sometimes seen taking away the nestlings, but not the eggs.

During the breeding season the Bonnet macaques (*Macaca radiata*) in troops swim across the river to the islets and plunder the eggs from the nests. The Bonnet monkeys cause heavy damage to the birds. The tourists going close to the islets in the boats aggrevate the situation as the birds leave their nests unprotected against the monkey damage. The birds ineffectively jab at the monkeys, which simply ignore this protest and pillage and feed on the eggs. When the river is in flood

ARRIVAL TIMINGS OF BIRDS TO RANGANATHITTU FOR BREEDING FROM 1972 TO 1977

Species	YEARS					
	1972	1973	1974	1975	1976	1977
Openbill Stork	May, 3rd week	Not recorded	June, 1st week	Middle of June	May, 3rd week	June, 2nd week
Large Egret	May, 3rd week	May 3rd week	June, 3rd week	June, 1st week	June, 2nd week	June, 1st week
Median Egret	Not recorded	Not recorded	May, 4th week	June, 1st week	June, 1st week	June, 3rd week
Little Egret	May, 3rd week	Not recorded	May, 4th week	June, 1st week	June, 1st week	June, 3rd week
Cattle Egret	May, 3rd week	Not recorded	June, 4th week	June, 1st week	June, 1st week	June, 3rd week
White Ibis	June, 1st week	Not recorded	July, 1st week	June, 2nd week	June, 4th week	June, 3rd week
Spoonbill	June, 4th week	Not recorded	July, 1st week	July, 1st week	July, 4th week	July, 1st week

the monkey damage is averted as the macaques cannot swim in the turbulent river. The climax of the egg laying period takes place when the river is in spate, which prevents damage from monkeys to a great extent.

Floods. Within about ten miles upstream of the Sanctuary a big dam known as K.R.S. dam occurs across the Kaveri River. The impounded waters are, from time to time, released for irrigation. This sudden release of waters causes heavy damage to the breeding birds by washing away the low built nests and the nesting vegetation. Sometimes even some portions of the islets are washed away.

When the birds arrive for breeding in the months of May and June the water level of the river is low. The birds build their nests on all the vegetation including the low vegetation. In the months of late July, August and early September there will be floods due to release of waters from the upstream reservoir, which wash away all the low built nests.

Median, Little and Cattle Egrets and the Night and Pond Herons are much affected by the floods, as they nest at lower levels. Openbill storks, White Ibis, Cormorants and Darter are not much affected by the floods, as they nest above the flood level.

Inter and intra specific relationships. The birds nest in their own separate colonies, occupying the same niches year after year. This tendency for segregation and sticking to almost permanent niches for nesting naturally avoids to a great extent interspecific competition amongst various species, although some competition cannot be ruled out at the fringes.

As the birds nest in segregated colonies, with closely packed nests, intra-specific competitions and fights do take place to some extent, although the birds are by and large not aggressive.

Departure and migration. By end of October the water flow in the river is much reduced. Release of water into the canals is also stopped. The paddy fields are dry. The young birds are also sufficiently grown to take care of themselves. This is the time when most of the heronry birds, that bred, leave the Sanctuary; and by November most of the birds are gone.

As the water in the river is much reduced by November the sheet rocks and boulders in the river are exposed and on these birds like the Great Stone Plover (*Esacus magnirostris*) and the Indian River Tern (*Sterna aurantia*) breed.

It is not known from where the heronry birds come to Ranganathittu for breeding and to where they go after breeding. To study this, ringing of the young was taken up in September 1975 with the help of the Bombay Natural History Society. Recovery reports are not yet reported.

Crocodiles and other animals. Marsh Crocodiles (*Crocodylus palustris*) also breed at Ranganathittu. They are often seen basking on the exposed sheet rocks in winter (November to February). Otters (*Lutra* sp.) are occasionally seen. Fruit Bats (*Pteropus giganteus*) roost in hundreds during day time on some of the larger trees along the bank of the river and on the main island where the heronry birds do not breed. Ranganathittu is also a Sanctuary for fish; and thirteen species are known to breed.

Tourism. The heronry attracts annually about a lakh of tourists. Boats and coracles are provided to take the visitors on the river for rowing round the islets to see the breeding birds. The money collected for entrance, boating, photography etc. from the visitors, forms a sizable revenue.

NOTES ON BREEDING BIRDS

OPENBILL STORK (*Anastomus oscitans*)

With the onset of premonsoon showers in May/June about 200 Openbills come for breeding at Ranganathittu. They nest almost exclusively on a lone, medium sized, *Terminalia arjuna* tree that stands in mid-river. Some Openbills also nest on low growing *Ficus glomerata, Pongamia glabra* and *Pandanus* plants that also stand in water. The *Terminalia arjuna* tree holds the main colony. Unoccupied spaces on the trees are utilised for nesting by some Egrets, Darters, Little Cormorants, Night Herons and Pond Herons (the last three species inside the foliage). .

When the Openbills arrive in May/June their plumage is snow-white except the deep purplish (greenish tinged) remiges and charcoal black tail. Later as the season advances the snow-white coat changes gradually to light grey, which looks dirty. The change of colour from white coat to light-grey coat is so natural and gradual that one misses it. When the Openbills commence building nests, which is usually by the end of 3rd week or beginning of 4th week of June, all have snow-white coat. This white-coat continues throughout July, when about 50% of them will have laid eggs and others will be building nests. The birds start turning greyish as the incubation period advances and by the 3rd week of August about 50% of the birds would have become grey and the remaining 50% would be turning grey. A few may remain (ten seen in August 1977) in pure white plumage. By end of August all breeding birds would have turned light grey, by which time they will have chicks in the nest. One bird with white coat was seen as late as in the 1st week of September in 1977, when all others had turned light grey, but this had no nest. Again by January onwards the greyish coat starts turning whitish; and this process of change of colour continues upto April, as seen from some birds remaining in the sanctuary.

The young from the nestling stage to subadult have light greyish colour. When the subadults become adults (in the next year) i.e., when the gap in their bills becomes prominent, they also commence putting on the white coat of maturity by late June.

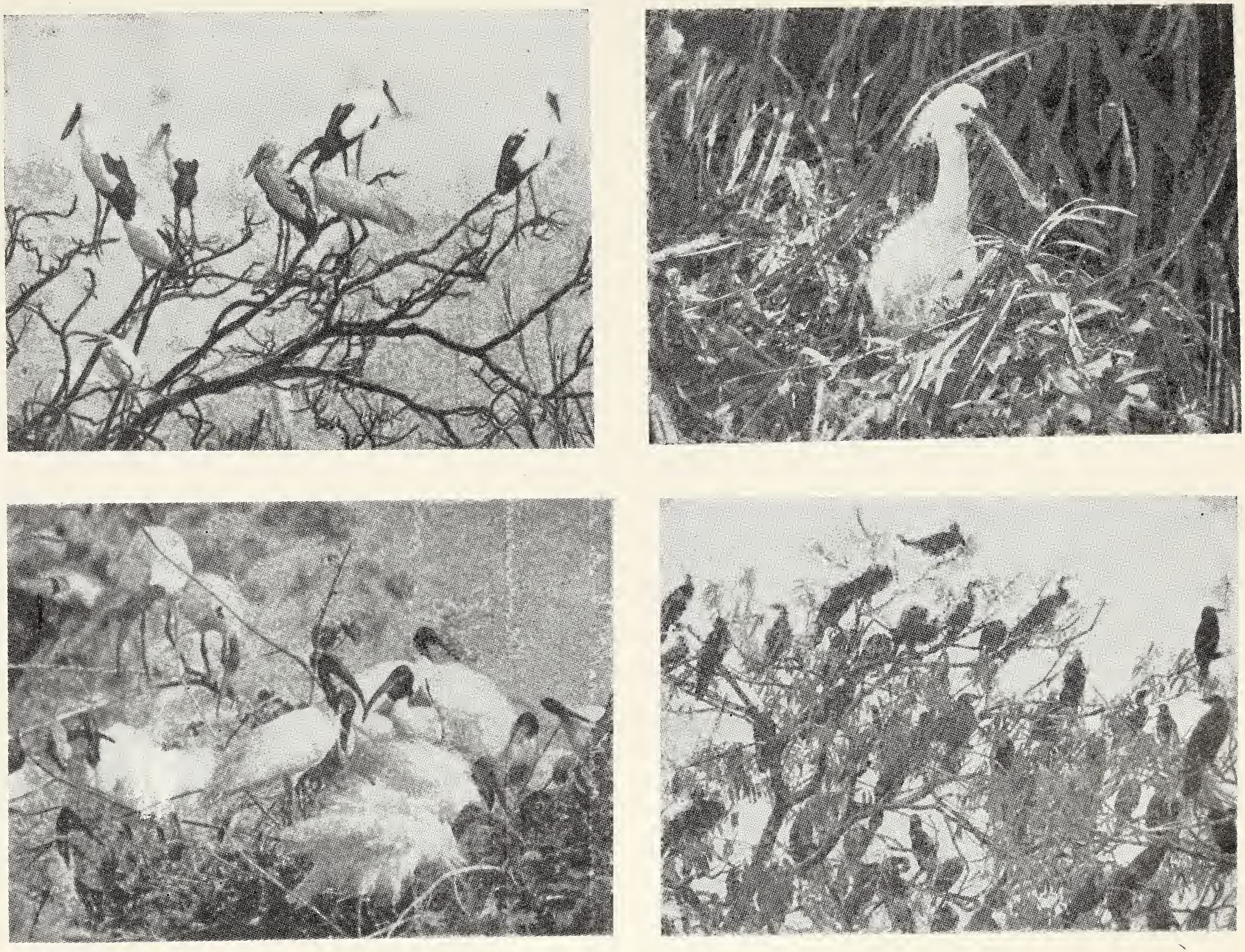
In 1975 the Openbills were seen mating on 15-vi-1975 and commenced nesting on 21-vi-1975. Matings were seen upto 2-viii-1975.

Kahl (1970) has recorded for Bharatpur that the Openbills regurgitate a quantity of water over the eggs. This was not observed at Ranganathittu.

The Openbills normally raise only one brood at Ranganathittu. A few also raise a second brood, if their first clutch of eggs is pillaged by the macaques and crows. As these birds nest at a higher level i.e., well above the flood level, they are not affected by floods, which destroy the low built nests of other birds at this sanctuary. So most of the Openbills do not have the need to raise a second brood.

A few juveniles with undeveloped gap or just developing gap in their bills are seen to accompany adult Openbills, that come for breeding at Ranganathittu, at the beginning of the breeding season (such sub-adults, however, number hardly about 5 to 10 each year).

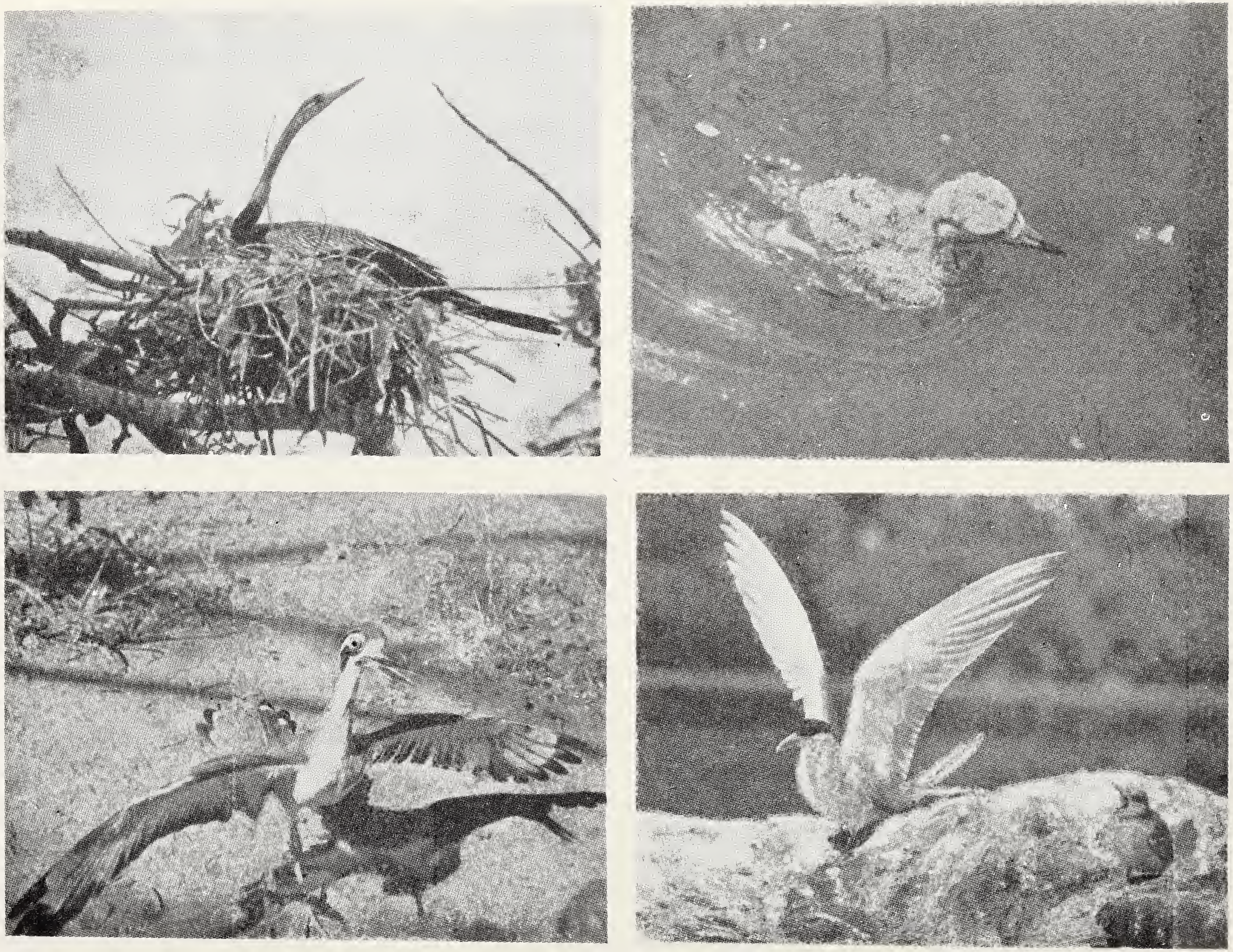
From the third week of August onwards chicks are seen and the parents make several sorties to feed the chicks. One of the pair always stands as a sentry over the chicks till the other partner returns with food. In August, September and October, when the days are hot, the parents, protect the young against the sun by providing shade with their half or fully spread wings. In some nests both the eggs and chicks are seen together, which fact explains



Left—*Above*: Openbills in their white nupital coat, as they arrive for breeding. The one at the centre, by the side of White Ibis, is having grey coat. *Below*: White Ibises busily engaged in nesting on low bushes. Right—*Above*: A Spoonbill incubating at its nest on a *Pandanus* thicket. *Below*: Little Cormorants on a *Salix* plant.

(Photos: *S. G. Neginhal*)

PLATE II



Left—*Above*: A snake-bird incubating at its nest. Mark silvery-grey plumes on its back. *Below*: A Great Stone Plover exhibiting strange behaviour at the Mysore Zoo. It used to come and attack the cage keeper in this fashion. It was trying to protect its false egg — a roundish stone!

Right—*Above*: The chick of the Great Stone Plover swimming in the waters to go to the other rocks. *Below*: A River Tern descending on its nesting rock. The nestling at the right corner is calling at its parent.

(Photos: *S. G. Neginhal*)

the size-difference later seen in the fledglings in some cases (normally all the young ones in a nest are uniformly sized).

When boats carry visitors very near to the nesting trees, the parent birds move or fly away from their nests. The crows (both House and Jungle) at this moment rob the eggs and the young chicks. The parent birds, even if perching within a distance of one metre of their nests do not defend their nests in such circumstances. But if men clear out at once, the birds immediately rush back to their nests and scare away the crows. If in the mean time the crows have done damage to the eggs, the parent birds pick up such broken eggs in their bills and throw them out. I have also seen parent birds threatening the crows coming near their nests and protecting the nestlings by covering them with their slightly spread out wings, if men are not nearby in boats.

The Openbill fledglings stay in their nests and are dependent on their parents for a longer time than those of other species. The parents were seen to feed them at their nests, in some cases, as late as December-January long after other breeding birds had left the Sanctuary.

The fledglings spend most of their time in the nests unlike the fledglings of other species and over 70% of the fledglings are at their nests as late as November. From November onwards the parents are away most of the time of the day outside the sanctuary, leaving the young to spend time by themselves in the Sanctuary.

As soon as the parents land down at the nest (at times even earlier as the fledglings sight their parents in the sky) the fledglings stand in a semicircle and commence squealing, and till the food is regurgitated on to the floor of the nest the fledglings keep on squealing and moaning. They half open their wings, raise the tail-feathers and move the head up and down, pointing to and hitting with their bills on the floor of the nest. If the parent does not disgorge the food early, the young peck at the feet and bill of the parent and again hit the floor of the nest with their bill. The squealing continues till regurgitation takes place, on which the young feed noisily and greedily. The parent regurgitates food rapidly several times at the centre of the nest. Quite often, when the parents of adjoining nests land at their nests, the young first commence their routine squealing but later stop when they realise their mistake.

Once I saw a parent Openbill coming to its nest and feeding its three young ones by regurgitating. At this juncture a grown up fledgling came quite close to this bird. The parent Openbill immediately started jabbing at the intruding fledgling. A little later the fledgling again slowly and steadily approached the parent bird, submissively squealing and the parent this time kept quiet. This intruding fledgling might have been of the parent's earlier clutch (this is quite rare) or an orphan, which perhaps survives by getting food this way.

In some nests, if a second brood was being raised on account of damage to the earlier clutch by monkeys or by crows, a senior fledgling is often seen along with the younger brood of the second clutch. This senior fledgling on many occasions is pestered by the junior fledglings for food, which are seen collecting in a semi-circle around the senior fledgling and ceremoniously demanding food. If the senior has become a juvenile, it may even try to feed the younger fledglings of its nest, in the absence of its parents who are out foraging. In mid January 1976, I observed one sub-adult (without the development of the gap in the bill) Openbill bringing a small round shelled mollusc in its bill to a nest. As soon as it landed on its nest another younger fledgling that was already in the nest started ceremoniously demanding food. The subadult that had brought the food obliged. It was also seen disgorging other food. Both the parents of this nest had gone out, when this happened.

The fledglings of one nest do not steal the food of the adjoining nests, but wait for their own parents to come and feed them.

The frequency of feeding of the young ones is much reduced from November onwards, and the fledglings are left to themselves most of the day. By January most of the fledglings leave their nests and spend time on the rocks in the river. Later they roost in the evening on river-side trees up-stream with adult Openbills and other species.

Initially, as the Openbills start breeding there is not much of intra-specific competition, but as more birds come the competition to occupy nesting sites sets in. In such circumstances the birds were observed fighting amongst themselves by jabbing and pecking at each other.

In October 1976 nests of three pairs of Openbills were seen on a bough of a tree, built very near to each other. All three nests had three nestlings in their nests and were covered by a parent bird in each nest. The parent bird in the middle nest was observed pecking at the bills of the parent birds standing in their respective nests, on either side whenever these two birds positioned themselves close to the middle nest.

Sometimes the Openbills suddenly erupt into quarrels amongst themselves for reasons best known to themselves. On one occasion, two Openbills, of one nest and two of an adjoining nest suddenly started jabbing at each other without any apparent reason. Both nests had eggs.

The fledglings are also seen to defend their nests against the fledglings of adjoining nest if they inadvertently intrude.

EGRETS

Ranganathittu provides rare opportunities for studying the breeding behaviour of four Egrets namely *E. alba, E. intermedia, E. garzetta* and *Bubulcus ibis*. These birds offer an added charm to this heronry with their attractive breeding plumage. Together they form the majority of the breeding birds of this heronry. Amongst themselves *E. intermedia* and *E. garzetta* form the majority.

EASTERN LARGE EGRET (*Egretta alba*)

No detailed study has been done on the food habits of these birds at Ranganathittu. It is of interest to note that in September 1975, while ringing young ones of the breeding birds at Ranganathittu, a nestling of a Large Egret while being handled disgorged from its crop, seventy eight fish fry due to fright. Another nestling vomited some fish fry and a half digested small crab.

The birds put on two attractive nuptial costumes during the breeding season namely snow-white dorsal plumes and beautiful blue colour on the lores and orbital skin (Salim Ali 1968). These plumes are often kept erect and spread out during courtship and nidification periods. The intra- and inter-specific competition for acquiring and defending nesting sites also provoke these birds to spread out the plumes. The plumes adorn the birds right from their arrival in May/June to middle of August, when they will have nestlings, Later they disappear. The blue colour of the orbital skin does not last long. It is bright blue in May/June and starts fading and reducing as soon as the birds have eggs by the middle or third week of July. By the time the birds have nestlings, the blue colour completely fades in the fourth week of July and disappears by the third week of August.

The birds do not segregate but nest in association with Openbill Storks, Median and Cattle Egrets, Night Herons, Paddy birds and Darters. They prefer the low *Pandanus* thickets to the tall trees for nesting.

Mating is seen in the months of May/June as soon as they come for breeding.

In July 1976, I saw a Large Egret, with blue coloured lores, attempting to mount a Median Egret, with Yellowish-orange coloured lores. The latter obliged without protesting and the male Large Egret had mounted the female Median Egret, but before the copulation could take place another Large Egret with the blue lores came and drove away the mounting Large Egret. This incident suggests the possibility of occurrence of inter-species mating between Large and Median Egrets.

Both sexes take part in incubation. One of the parents is always at the nest when they have eggs or nestlings. The nestlings soon grow into fledglings, and when they are large enough to be beyond predation both the parents were observed going out for foraging. While the parents are away the fledglings leave their nests and take shelter in the foliage of the nesting plants till their parents return to feed them. When the days are hot (34-35°C.) the parents shield their nestlings against the sun by providing shade with their half open wings.

Whenever troops of macaques raided the Large Egrets were seen squealing and protesting and even jabbing at the monkeys. Once after the monkeys had left a *Pandanus* thicket after pillaging the nests, a Large Egret was seen returning to its nest and picking and throwing into the river its damaged eggs.

SMALLER OR MEDIAN EGRET *Egretta intermedia*

Birds with both black iris with a white ring and birds with reddish iris without the white ring were seen. Whether these characters indicate sex difference needs to be studied.

The Median Egrets develop attractive Yellowish-orange colour on the orbital skin and on the lores during the breeding season. The birds have this bright nuptial colour from May/June to end of July. As the birds lay eggs the yellowish-orange colour on the lores starts fading and reducing in area. By the time they start having chicks a much faded yellowish colour remains on the skin around their eyes, and by end of August the colour completely disappears. Unlike the Large Egrets, the Median Egrets develop nuptial plumes both on the back and on the breast, the latter being shorter. The nuptial plumes are often kept erect to look like "Misty-showers". The birds have the plumes from the fourth week of April to end of August, when they normally have chicks in the nest.

These birds nest gregariously in association with the Little Egrets, almost at ground level, on the low thorny tangles of *Caesalpinia bonducella* growing on the "Rain-tree island". Some of these birds also nest in a scattered way on small trees and on *Pandanus* thickets in association with other birds.

It is of interest to note that these birds (Little Egrets too) collect the floating grass, straw, tiny twigs and sticks, that come down the river in the floods, for constructing the nests, in addition to the nesting material that they bring from outside. They fly low over the water and pick up the floating and drifting nesting material with their bills.

Initially when these birds arrive for breeding, the heronry resounds to their croaking sounds while they jealously defend their nesting places.

When the Bonnet monkeys raid the islets the Median Egrets jab and lunge at the monkeys, keeping erect their plumes. They go on squealing and croaking till the intruders vacate the islets. On one occasion four Median Egrets were observed unitedly jabbing at a raiding macaque.

LITTLE EGRET *Egretta garzetta*

Little Egrets come in more numbers to breed at Ranganathittu than the other Egrets. They have yellow feet as a rule, but a few have pink feet also.

Two long nuchal plumes (nuptial plumes) adorn these birds from about third week of April to end of August, by which time they have chicks. The orbital skin also gets light greenish yellow in colour, which is not so prominent as that of the breeding Large and Median Egrets. (Birds with pink feet develop pink colour on the orbital skin.)

These Egrets nest gregariously on the low *Caesalpinia bonducella* tangles, on "Rain-tree islet" in association with the Median Egrets. Some also nest among other birds. The Little Egrets also collect the floating and drifting nesting materials.

Little Egrets are comparatively more aggressive than the other Egrets. They were observed vociferously acquiring and defending their roosting and nesting territories.

As already stated a few Little Egrets (3-4 pairs) with pink feet and pink lores and pink orbital skin were observed coming to Ranganathittu for breeding. They bred separately — not mixing with the normal Little Egrets with yellow feet. They have two long nuchal plumes also, and shed these after the breeding is over.

CATTLE EGRET *Bubulcus ibis*

The birds start turning golden buff (their nuptial costume) by early or middle of March. The buff colour first covers the face and neck and then slowly spreads on the back and breast. After the peak of the breeding season is over, the bright buff coat starts fading. By first week of October, when the birds have fledglings, these become almost white; and by end of October the birds turn snow-white again.

By the second week of June the birds commence nesting. They do not nest gregariously but in association with other Egrets, Night and Pond Herons. The Cattle Egrets very jealously guard their nests.

WHITE IBIS *Threskiornis melanocephala*

The white ibis nest gregariously on low vegetation. Such of the birds that come late in the breeding season even nest in communes on the bare ground of "Rain-Tree islet." This was observed in 1973 and 1975 when a large number of white ibises came for breeding. They nested gregariously on the ground using a bare minimum of twigs and some had laid eggs on the ground without even forming nests!

Most of the hatchlings are seen in August. The hatchlings grow remarkably fast into fairly large sized nestlings within a week. When hardly one month old, they start crawling about and get mixed up with the young ones of adjoining nests of their kind.

In October the grown up juveniles are seen flying around and spending their time in groups on the exposed sheet rocks of the river, feeding by themselves on titbits till their parents come and feed them.

SPOONBILL *Platalea leucorodia*

Only 6 to 7 pairs come to Ranganathittu for breeding. Their number has remained remarkably constant through out these years.

These birds come quite late in the season and seem to be exacting in their requirement of breeding conditions. Unless favourable conditions are available, they do not take up nesting and may even skip a year without breeding, if proper conditions are not available. This happened in 1976, when five pairs of spoonbills were seen but none nested. Floods seem to have some bearing on breeding of these birds at Ranganathittu. Initially on arrival they are seen spending their time by standing and dozing on the rocks and plants. As soon as the river is in spate they spring into action and commence nesting.

Spoonbills have a favourite nesting place at Ranganathittu, where they nest on low growing shrubbery, at a corner of 'Rain-tree' island, segregating into their own colony, with no other birds nesting nearby. But this traditional place was temporarily abandoned in 1975, when the unusual floods washed away their nests and eggs.

CORMORANTS *Phalacrocorax* sp.

Three Species of Cormorants come to Ranganathittu. Large Cormorant (*Phalacrocorax carbo*); Indian Shag (*Phalacrocorax fuscicollis*); Little Cormorant (*Phalacrocorax niger*).

Little Cormorants in hundreds come and roost at Ranganathittu, but only about fifty pairs breed here in the season. Large Cormorants and the Indian Shag irregularly breed. In the years 1972 and 1973 only 2-3 pairs of Large Cormorants nested and although a few pairs came from 1974 to 1977 they did not nest. The Indian Shags also irregularly nest. Between the years 1972 and 1977 the Indian Shag nested (six pairs) only in 1976, which was surprisingly a drought year, when monsoons failed and the river did not flood.

Little Cormorants commence nesting earlier than the other two Cormorants in June/July. The Large Cormorants and the Shags nest later in August/September. Little Cormorants nest on medium sized trees in association with Darters, Egrets, Openbill Storks etc.

The Indian Shag has a tendency to segregate and is found nesting on the *Salix* on 'Salix' islet, on which the Darters also nest. The Large Cormorants build their nests on the lone large-sized Rain-tree (*Pithecolobium saman*) on Rain-tree islet. In addition to bringing nesting materials from the round about areas, the Little Cormorants were also observed collecting nesting materials that come drifting down the river.

DARTER OR SNAKE-BIRD *Anhinga rufa*

The Darter prefers the low growing *Salix* trees for nesting. They nest gregariously. Some birds also nest in association with other birds. These (Night and pond Herons also) commence nesting earlier than other birds. By middle of April they are seen thumping down the vegetation to make their tops flat to begin the nesting and within a week their nests would be almost half ready. Nidification may be postponed to May or June depending on monsoon conditions. At the time of nesting, and even a little earlier, these birds become noisy, and call repeatedly with a "Keke-Ko, Keke-Ko". They also keep erect their nuptial silvery-grey plumes on their back while defending their nesting sites and nests. They are more vociferous in April/May; and in later months they become almost silent. By middle of May they are seen incubating in their nests with their long necks and tails projecting outside their nests.

Both sexes take part in nest building and other activities. The birds also collect floating twigs for nesting (in addition to fetching material from outside). The snow-white nestlings turn grey as they grow into fledglings.

Night Heron *Nycticorax nycticorax*

These crepuscular birds become conspicuously diurnal during the breeding season. The Night Herons are seen sitting and suspiciously staring at the intruders with their large blood red eyes, their general coloration so naturally blending with the vegetation that, unless they fly, they are not easily sighted. The birds which are silent during the day, become noisy at dusk; and commence flying noisily about giving out a harsh "Kwack, Kwack" call. Night Herons are seen foraging in the freshly transplanted paddy fields. While ringing, a fledgling disgorged quite a big fish, remarkable for the fledgling's small size. These birds (and Little and Cattle Egrets also) are at times seen around Crocodiles that bask on the rocks, perhaps to feed on the ectoparasites.

The two long nuptial plumes (nuchal) are kept erect during various competitive and aggressive activities of the breeding birds. Although nidification activities are mostly seen in the afternoons, the birds are sometimes observed carrying nesting twigs even during the mid day. The birds vehemently defend their nesting sites against other birds. They prefer *Pandanus* breaks for nesting, and nest gregariously in association with other birds. Though some birds are seen with eggs as early as the third week of March, the birds generally commence nesting in April/May.

The Night Herons defend their nests against Crows and Bonnet Monkeys by fluffing out their feathers, raising their crest feathers and jabbing. They squeal and protest till the monkeys move away from their nests.

These birds do not easily give up their drowning nests during floods. They sit tightly on their nests, till the rising waters forcefully drag away the nests. During floods I saw many of these birds sitting tightly on their nests, which were lifted off by the rising waters and were being carried away down stream. The Night Herons floated down the river sitting on their nests and only when their nests disintegrated did they fly off.

Indian Pond Heron or Paddy Bird *Ardeola grayii*

The Pond Heron has an attractive bluish colour to its orbital skin and looks handsome with its changed nuptial colour of dark reddish colour during the breeding season.

Pond Herons favour *Pandanus* thickets for nesting. They repair the previous-season's nests for breeding in addition to building new ones. They nest in loose association with Night Herons and Egrets, and occupy the lower and interior portions of the vegetation (like the Night Herons) for nesting.

Eastern Purple Heron *Ardea purpurea*

These are very shy birds, and at the sight of man, even from a distance they fly away inconspicuously without making any sound. Only in 1977 did I spot the Purple Heron breeding a little distance upstream from the main islets on which other birds normally bred. It was a chance discovery. The Purple Herons gregariously nest in exclusive colonies, on *Pandanus* thickets that stand in the river. The birds nest on the top of the *Pandanus* after flattening the leaves. The nests are markedly small in size compared to the birds' large size. The light blue eggs are quite big. I have observed these birds incubating from January to June.

As one goes in the boat to the nesting colony of Purple Herons, the birds leave their nests unprotected and go and perch on nearby trees, watching the intruders. However when crows come to take advantage of this situation to rob the nests, the Purple Herons immediately return to their nests to protect their nests, if the men in the boat are reasonably away or prudently withdraw. While returning to protect their nests, the birds give out a peculiar protesting harsh 'honks' with the plumes on their crest (nuptial) raised. They jab at the crows and drive them away.

GREAT STONE PLOVER *Esacus magnirostris*

Great Stone Plovers commence breeding at Ranganathittu after the breeding season of the heronry birds is over. As the river recedes, (soon after the monsoons are over) these birds appear on the exposed sheet rocks, on which they breed. They are often seen during the day dozing and drowsing on the rocks, surrounded by water. If men in boats go towards them, they fly giving out agitated and quick "Kill-ick, Kill-ick, Kill-ick" calls in quick succession.

One to two eggs (two common) are laid on the bare sheet rocks surrounded by deep water, in the middle of the river. Sometimes eggs are laid at the base of short grasses growing on the rocks. The eggs are at times seen surrounded by dry fallen leaves of nearby shrubbery. The nests cannot be easily traced out although in the open, the camouflage being so perfect. As the incubation advances the eggs become smudged and covered with red and white coloured excreta. This makes the surroundings so natural that the eggs are not easily spotted by nest-robbers.

I have seen these birds with eggs in all the months from November to March. While one of the parents is incubating, the other is usually found nearby squatting and dozing. The birds are very timid and wary. On near approach the incubating birds get up and start running from one end of the rock to the other calling with a deep whistling note and keeping watch over the intruder's movements. Ultimately they fly away taking a long semi-circle, but keep watch on the intruder from a distant rock. If a crow tries to take advantage of the situation, the birds immediately return to their nests to protect the eggs (if we clear out in the meantime). The nesting River Terns (*Sterna aurantia*) in the vicinity offer added indirect protection to the nests of these birds, as the River Terns vehementally drive away any intruder coming in the neighbourhood of their nests. Once a pair of River Terns were seen attacking even a nearby Great Stone Plover which was incubating in its nest. The Stone Plover fanned out its tail and ducked several times to avoid the attack of the River Terns.

Sálim Ali (1969) states that the incubation period of the Great Stone Plover has remained undetermined. However from my field observations I deduce the incubation period of the birds to be 28 days.

While I was the Curator, Mysore Zoo a Great Stone Plover had laid an egg on 28-1-1978, which hatched on 26-2-78. So the incubation period at the Zoo was also 28 days.

Even one day old chicks are marvellously active. They run about quite fast on the rocks. They can also swim quite swiftly and easily and go from one rock to the other, when followed. They lie doggo either floating in water or on the rocks with their eyes wide open, watching the activities of the intruders. Their colour so perfectly camouflages that hours of searching may be futile, even when the nestlings are quite close by. As the boats go near the nesting rocks the parents give a cautioning deep whistling and the nestlings freeze. A nestling was observed lying doggo for full two hours. Once a one day old chick was observed swimming in water and going from one rock to the other continuously for 45 minutes. Even a fortnight old nestling suddenly hides in the crevices of the rocks, on hearing the cautioning whistle of their parents on the approach of intruders. They feign death without moving but with eyes wide open. They do not move even after one takes them in one's hand and even after keeping them back on the rock. They are amazingly immobile for an indefinite time till the intruders clear out.

At the Mysore Zoo I observed the strange behaviour of a captive pair of adult Great Stone Plovers. On entering the cage the pair used to come and attack the cage keeper and others by keeping their wings horizontally spread out and their tail feathers fanned out. I soon found the reason for this strange behaviour. The pair was trying to protect their false egg; a roundish stone of their egg size. As the cage keeper with a broom went near this stone, on which one of the birds was squatting as if to incubate, it used to issue out hissing sounds and fly up at his face. On keeping the broom on the ground the bird would vehementally pull out the long leaves of Agave plants planted inside the cage with its bill. A re-directed action! This behaviour was not, however, observed in the wild at Ranganathittu, where the birds were very timid, though I went very near to the nests. The parents used to stand far away on other rocks observing my activities.

Indian River Tern *Sterna aurantia*

River Terns are seen at Ranganathittu by October after the main breeding season of the heronry birds is over. At this time the waters become still as the river almost stops flowing; and the River Terns are seen flying over the Ranganathittu reservoir in an "Up and down" manner, or are found sitting on rocks. The birds commence pairing by November, and then become noisy.

In the natural depressions of bare rocks exposed by the receding water, in the midst of the Ranganathittu reservoir, the River Terns lay eggs. Sometimes gravel may be found around the eggs, which help to prevent the eggs rolling down into the water. Year after year the same rocks and depressions, even when disturbed are used for laying eggs.

Two to three eggs are laid in each clutch. More than one brood is raised in each season. Even when the fledgling of the first clutch is present, the parents start the second clutch. The eggs are seen from January to May and are smaller in size compared to the eggs of the Great Stone Plovers.

The chicks freeze in the depressions of the rocks on hearing the warning calls from their parents on the near approach of men. Their greyish colour perfectly camouflages with the greyish colour of the nesting rocks. As the chicks are on bare hot rocks they need to be kept cool by the parents. So one of the parents is always at the nest keeping the chicks below its breast and thereby giving protection against the hot sun. The parents are also seen flying very low over water and grazing against the water-surface, keeping their wings horizontally stretched, to wet their feet, stomach and breast. After this skating on water-surface, the parents fly back and settle on their nests, putting the chicks below their wet breast and stomach to moisten them. This helps them to considerably cool their chicks and the hot rocks below. The chicks also appear to lick the wet breast feathers of their parents to quench their thirst. This grazing flight is also performed as a re-directed action against intruders. The nestlings were observed calling to their parents flying above them with a whistling note.

The hatchlings were not observed swimming immediately on hatching, as the hatchlings of the Great Stone Plovers do. However 3-4 days old chicks enter water and paddle at the sight of approaching human beings. Some nestlings even took 15 days to get into water and swim. They would helplessly stand at their nests even without running. The nestlings have slightly developed webbed feet, which help them to paddle and later swim in water. When their young get into water and start swimming from rock to rock to evade approaching human beings, the parents follow them in the air giving out anxious assuring notes. The nestlings lie doggo and feign death till the observers move away. Even swimming nestlings are observed to feign death by becoming absolutely immobile and freezing and floating in the water, keeping their eyes wide open, till the observers move away. When the young are about 23 to 25 days age they commence flying from rock to rock. Both parents continue taking care even after the young start flying. Even when the parents raise their second clutch the fledglings are seen resting by the side of the incubating parents, and even at this stage they are dependent upon their parents for food.

The River Terns jealously guard their nests and the young. Inspite of this, crows rob the eggs. How the crows manage to penetrate the surveillance of the terns is an unobserved mystery to me. However in many cases the eggs are lost before hatching. Bonnet monkeys and perhaps otters, may also cause damage. In addition many of the second and third clutches are washed off by the unpredictable premonsoonic showers.

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MATERIAL FOR THE FLORA OF MAHABALESHWAR—4

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[*continued from Vol.* 79(2):323]

ASTERACEAE

1. All florets on the same head bearing same colour 2
2. All florets orange, yellow or white 3
3. All florets orange ....*Gynura*
3. All florets yellow or white 4
4. All florets white 5
5. Florets in same head either all ligulate or all tubular 6
6. Florets all ligulate .... *Lactuca*
6. Florets all tubular 7
7. Stems with white cottony pubescens . . .. *Echinops*
7. Stems without white cottony pubescens......8
8. Stems glabrous, prostrate or spreading . . .. *Caesulia*
8. Stems pubescent; plants erect 9
9. Leaves alternate 10
10. Heads collected in globose or ovoid clusters .... *Anaphalis*
10. Heads not collected in globose or ovoid clusters 11
11. Pappus absent .... *Artemisia* (p.p.)
11. Pappus present .... *Parthenium*
9. Leaves opposite 12
12. Involucral bracts very acute, ribbed on the back, ciliolate and scarious on the margins . ... *Ageratum*
12. Involucral bracts obtuse or sub-acute, glabrous, glandular or scabrid; margins not scabrous . . .. *Adenostemma*
5. Inner and outer florets in the same head different 13
13. Leaves sessile . ... *Eclipta*
13. Leaves petiolate 14
14. Palea narrow; pappus of 2-4 spreading awns . . .. *Bidens* (p. p.)
14. Palea concave; pappus 0 or of few unequal acute scales 15
15. Achenes ciliate; pappus 0 ....*Spilanthes*
15. Achenes not ciliate; pappus of few scales . . .. *Blainvillea*
4. All florets yellow 16
16. Achenes curved, muricate ....*Calendula*
16. Achenes not curved, not muricate 17
17. Leaves lobed 18
18. Plants with radical leaves 19
19. Pappus absent . . .. *Cyathocline*
19. Pappus present . . ..*Sonchus* (p. p.)
18. Plants without radical leaves 20
20. Leaves alternate 21
21. Florets either all ligulate or all tubular.....22
22. Florets all ligulate .... *Sonchus* (p. p.)
22. Florets all tubular ....*Artemisia* (p. p.)
21. Outer florets ligulate, inner tubular . . ..*Senecio* (p. p.)
20. Leaves opposite 23
23. Pappus of 2-4 retrorsely hispid hairs . . .. *Bidens* (p. p.)
23. Pappus of many aristate, feathery bristles . . .. *Tridax*
17. Leaves entire or serrate, not lobed 24
24. Radical leaves present 25
25. Florets outer ligulate, inner tubular .... *Senecio* (p. p.)
25. Florets all ligulate .... *Sonchus* (p. p.)
24. Radical leaves absent 26
26. Leaves opposite 27
27. Achenes ciliate .... *Spilanthes* (p. p.)
27. Achenes not ciliate 28
28. Achenes of ray florets cuneiform .... *Blainvillea* (p. p.)
28. Achenes of ray florets not cuneiform 29
29. Achenes of two types .... *Synedrela*
29. Achenes of one type 30
30. Achenes longitudinally ribbed; pappus absent .... *Guizotia*
30. Achenes not ribbed; pappus a ciliolate ring . ... *Wedelia*
26. Leaves alternate 31
31. Outer florets ligulate, inner tubular 32
32. Leaves sessile or subsessile 33
33. Anther bases obtuse entire .... *Conyza*

33. Anther bases variously tailed or sagittate....34
34. Involucral bracts 1-2 seriate, equal .... *Senecio* (p. p.)
34. Involucral bracts many-seriate, unequal .... *Vicoa*
32. Leaves petiolate 35
35. Achenes of the disc florets truncate, triquetrous 36
36. Pappus of 2-5 unequal bristles ....*Blainvillea* (p. p.)
36. Pappus of 15-20 fimbriate scales.....*Galinsoga*
35. Achenes of the disc florets not triquetrous 37
37. Achenes 5-10 ribbed .... *Senecio* (p. p.)
37. Achenes not ribbed 38
38. Heads less than 2 cm across .... *Vicoa*
38. Heads more than 10 cm across.....*Helianthus*
31. Florets all tubular, or tubular and ligulate in the same head, but ligulate ones are small and inconspicuous 39
39. Leaves petiolate 40
40. Pappus absent ....*Artemisia* (p. p.)
40. Pappus present 41
41. Pappus copious .... *Notonia* (p. p.)
41. Pappus uniseriate, slender ....*Blumea* (p. p.)
39. Leaves sessile or subsessile 42
42. Pappus absent .... *Artemisia* (p. p.)
42. Pappus present 43
43. Pappus many seriate ....*Notonia* (p. p.)
43. Pappus 1-2 seriate 44
44. Anther bases obtuse, entire ....*Conyza*
44. Anther bases sagittate 45
45. Heads solitary .... *Blumea* (p. p.)
45. Heads in clusters ....*Gnaphalium*
2. Florets in the head red, pink, purple, violet or blue 46
46. All leaves sessile 47
47. Anthers tailed .... *Eupatorium*
47. Anthers not tailed 48
48. Receptacle densely bristly ....*Carthamus*
48. Receptacle not densely bristly 49
49. Leaves all radical ....*Elephantopus*
49. Leaves all not radical 50
50. Leaves white tomentose beneath .....*Vernonia*
50. Leaves not white tomentose beneath 51
51. Pappus absent or of few short hairs 52
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52. Involucral bracts not scarious ......*Adenoon*
51. Pappus present .... *Vernonia* (p. p.)
46. All leaves petiolate 53
53. Leaves dense white tomentum beneath 54
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55. Fruits covered with hard spines .....*Xanthium*
55. Fruits not covered with hard spines 56
56. Leaves opposite .... *Ageratum* (p. p.)
56. Leaves alternate 57
57. Pappus uniseriate ....*Blumea* (p. p.)
57. Pappus 2-many seriate ...... *Vernonia* (p. p.)
1. Florets in same head with two or more colours 58
58. Leaves compound .... *Bidens* (p. p.)
58. Leaves simple 59
59. Florets all tubular ....*Artemisia* (p. p.)
59. Outer florets ligulate, inner tubular 60
60. All leaves petiolate ....*Dichrocephala*
60. Leaves cauline and sessile .... *Erigeron*

Adenoon Dalzell

1. **Adenoon indicum** Dalz. in Kew Journ. Bot. 2:344, 1850; Dalz. & Gibs. 121; FBI 3:299; Birdwood, 16; Cooke, T. 650 & 2:9 (2: 64); Puri & Mahajan, 125.

Frequent herb on exposed hill-slopes near Lingmala. Rarely seen at Bhilar Estate, Arthur seat and behind Madhu Kosh.

FLOWERS & FRUITS: October-November.
LOCAL NAMES: Kusamb, Mothi Sonki.

Adenostemma Forst.

1. **Adenostemma lavenia** (Linn.) O. Kuntze, Rev. Gen. Pl. 304, 1891; Santapau, 124.

Verbesina lavenia Linn., Sp. Pl. 902, 1753.
A. viscosum Forst., Char. Gen. 90, 1776; Graham, 98; FBI 3: 242; Birdwood, 16; Cooke, 650 & 2: 13 (2: 69); Puri & Mahajan, 125.
A. latifolium Don. Prodr. Fl. Nepal. 181, 1825. Wight, Icon. t. 1087; Dalz. & Gibs. 122.
A. rivale Dalz. in Kew J. Bot. 3: 231, 1851.

Common herb along the edges of the forests and along the water courses. Quite common at Kate's point, Wilson point, Lodwick point, Madhu Kosh, Fitzgerald ghat and Folkland point, but nowhere it is abundant.

FLOWERS & FRUITS: October-December.
LOCAL NAME: Jungli jira.

Ageratum Linn.

1. Leaves cordate at base; margins deeply crenate, not ciliate .... *A. houstonianum*
1. Leaves blunt or rounded at base, narrowing into the petiole; margins crenately dentate, ciliate . . .. *A. conyzoides*

1. **Ageratum conyzoides** Linn., Sp. Pl. 839, 1753; Graham, 243; FBI 3: 243; Cooke, T. 650 & 2:14 (2:70): Lisboa, 215; Birdwood, 16; Puri & Mahajan, 124.

Common weed of wastelands in white flowers. Whole plant has some unpleasant smell and locally applied for healing cuts and wounds by local people.

FLOWERING: Throughout the year.
LOCAL NAMES: Osadi, Ghanera

LOCALITIES: Chinaman's Falls, Petit Road.

2. **Ageratum haustonianum** Mill., Gard. Dict. ed. 8, no. 2, 1768.

An erect herb common in wet places near Chinaman's falls. Flowers blue in colour.

FLOWER: August-December.
LOCALITIES: Madhu Kosh, Chinaman's Falls, Dhobi's Falls.

Anaphalis DC.

Dr H. M. Birdwood (1897) has reported *Anaphalis oblonga* DC., in his catalogue. We have not seen this species at Mahabaleshwar and there is no reliable specimen in any of the herbaria consulted.

Artemisia Linn.

1. Disc flowers sterile .... *A. parviflora*
1. Disc florets fertile ....*A. nilagirica*

1. **Artemisia nilagirica** (Clarke) Pampanini. in Nov. Giorn. Bot. Ital. 33: 452, 1926.

A. vulgaris var. *nilagirica* Clarke, Comp. Ind. 162, 1876.

A. vulgaris auct. (*non* Linn., 1753) Hook f. in Flora Brit. India, 3: 325, 1881; Cooke, T. 2: 47 (2: 105); Puri & Mahajan, 125.

A. indica Graham, Cat. Bombay Pl. 102, 1839 (*non* Willd. 1801); Dalz. & Gibs., 112; Markham * 386.

A common undershrub in grasslands and along roadsides. Abundant at Bhilar Estate.

There is a certain amount of confusion regarding the nomenclature of this species. J. D. Hooker in Flora of British India (vol. 3: 325, 1881), gives a long synonymy under *Artemisia vulgaris* Linn. Rev. Fr. Santapau, in Fl. Khandala (ed. 3, p. 134, 1967) states "Pampanini (loc. cit.) has demonstrated that none of the Indian species of *Artemisia* corresponds to the European *A. vulgaris* of the Linnaean herbarium, and in this case the oldest name for the plant is that of Clarke, which is therefore raised to specific rank". J. D. Hooker while merging *Artemisia grata* Wall. *ex* DC. from western peninsula with *A. vulgaria* expresses his inability to separate these two species except that *A. grata* has broader leaves. Therefore we feel *Artemisia grata* Wall. *ex* DC. is the oldest name for our western peninsular species.

FLOWERS & FRUITS: October-January.

2. **Artemisia parviflora** Buch-Ham. *ex* Roxb. Fl. Ind. 3:420, 1832; Dalz. & Gibs. 314; Birdwood, 16; FBI 3:322; *Markham,

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* Clements R. Markham, 'Peruvian Bark', A popular Account of the introduction of Cinchona cultivation into British India. Chapter VIII. The Mahabaleshwar Hills, pp. 384-386, 1880.

386; Cooke, T. 650 & 2:47 (2:104); Puri & Mahajan, 125.

A. glabrata DC., in Wight, Contr. 20, 1834; Wight, Icon. t. 1111.

Common undershrub among the grasses. Very common at Bhilar Estate.

LOCAL NAME: Dauna.
FLOWERS & FRUITS: October-April.

1. **Bidens biternata** (Lour.) Merrill & Sherff ex Sherff, Bot. Gaz. 88:293, 2929; Santapau, Fl. Purandhar, 68, 1957.

Coreopsis biternata Lour., Fl. Cochinch. 508, 1790.
B. pilosa auct. (non Linn., 1753) Hook f., in Flora Brit. India 3: 309, 1881; Cooke, T. 650 & 2:44 (2:101); Birdwood, 16.
B. wallichii DC., Prodr. 5: 598, 1837; Graham, 101; Dalz. & Gibs. 128.

Common weed in wastelands and among grasses at Lingmala and Bhilar Estate.

FLOWERS & FRUITS: October-April.

Blainvillea Cass.

1. **Blainvillea acmella** (Linn.) Philipson, Blumea 6: 350, 1950; Chavan & Oza, Fl. Pavagarh, 125, 1966.

Verbesina acmella Linn., Sp. Pl. 901, 1753.
Eclipta latifolia Linn. f. Suppl. Pl. 378, 1781.
B. latifolia (Linn. f.) DC. in Wight Contr. Bot. Ind. 17, 1834; Dalz. & Gibs. 127; FBI 3: 305.
B. rhomboidea Cass. in Dict. Sc. Nat. 29: 494, 1823: Cooke, T 2:40 (2:97).

Rare species in wastelands and along roadsides.

FLOWERS & FRUITS: September-December.

Blumea DC. (nom. cons.)

1. Plants densely white wooly all over .... *B. malcomii*
1. Plants glabrate or pubescent, never wooly all over 2
2. Phyllaries at least the outer oblong-ovate to oblong-lanceolate .... *B. lanceolata* var. *spectabilis*
2. All phyllaries linear or linear-lanceolate......3
3. Capitula glomerate .... *B. fistulosa*
3. Capitula paniculate 4
4. Leaves spinous-toothed; corolla of both types of florets hairy 5
5. Heads in sessile, axillary clusters .... *B. belangeriana*
5. Heads in pedunculate clusters 6
6. Plants erect .... *B. eriantha*
6. Plants prostrate .... *B. oxyodonta*
4. Leaves not spinous-toothed; corollas of female florets glabrous 7
7. Achenes ribbed 8
8. Plants glabrate .... *B. virens*
8. Plants pubescent or glandular hairy . . .. *B. membranacea*
7. Achenes sub-angulate to terete 9
9. Leaves usually not lobed; corollas purple to lilac . . .. *B. mollis*
9. Leaves often lyrate; corollas yellow . . .. *B. lacera*

1. **Blumea belangeriana** DC., Prodr. 5:444, 1936; FBI 3:266; Cooke, T. 2:22 (2:78); Randeria, Blumea 10(1):277, 1960.

Rare species at Mahabaleshwar.
FLOWERS: December-February.

2. **Blumea eriantha** DC. in Wight, Contrib. Bot. Ind. 15, 1834; FBI 3:266; Cooke, T. 2: 22 (2:78); Randeria Blumea, 10(1):279, 1960.

Common along road-sides and in open forest areas.

FLOWERS: December-March.
LOCAL NAME: Nimurdi.

3. **Blumea fistulosa** (Roxb.) Kurz., Jour. As. Soc. Bengal, 46(2): 187, 1897; Randeria, Blumea 10(1):256, 1960.

B. glomerata DC. in Wight Contrib., 15, 1834; Dalz. & Gibs. 125; FBI 3: 262; Cooke, T. 2: 20 (2: 76), Birdwood, 16.
B. holosericea Dalz. & Gibs., Bombay Flora 126, 1861 (non DC., 1834).

This species is included here on authority of Birdwood. Cooke in Flora of Bombay Presidency reports it on the authority of Dalzell & Gibson only.

LOCAL NAME: Bhamburda.

4. **Blumea lacera** (Burm. f.) DC. in Wight Contrib. 14, 1834; Graham, 97; FBI 3:263; Cooke, T. 2:20 (2:76); Randeria, Blumea 10(1): 264, 1960.

Conyza lacera Burm. f., Fl. Ind. 180, t. 59, f. 1, 1768.

B. leptocladea Dalz. & Gibs., Bombay Fl. 126, 1861 (non DC., 1834).

Rare species at Mahabaleshwar.

FLOWERS: September-January.
LOCAL NAME: Burando.

5. **Blumea lanceolata** (Roxb.) Druce var. **spectabilis** (DC.) Randeria in Blumea 10(1): 220, 1960.

B. spectabilis DC., Prodr. 5: 445, 1836; FBI 3: 269; Cooke, T. 2: 23 (2: 79).

There is only one specimen of this species from Mahabaleshwar in Blatter Herbarium. Collected by L. J. Sedgwick.

FLOWERS: January.

6. **Blumea malcolmii** (Clarke) Hook f. in Flora Brit. India 3:266; 1881; Birdwood, 16: Crooke, T. 2:22 (2:78); Puri & Mahajan, 125; Randeria, Blumea 10(1):278, 1960.

Pluchea malcolmii C. B. Clarke, Comp. Ind. 95, 1876.

Rare herb among rocky places along Fitzgerald Ghat. Common near Chinaman's falls.

FLOWERS: October-March.

7. **Blumea membranacea** DC., Prodr. 5: 440, 1836; FBI 3:265; Cooke, T. 2:21 (2:77); Randeria, Blumea 10(1): 269, 1960.

Common and abundant herb on earthbanks on Fitzgerald Ghat.

FLOWERS: December-March.
LOCAL NAME: Mharbir.

7. **Blumea mollis** (Don) Merrill, Phil. Jour. Sci. Bot. 5:256, 1910; Randeria, Blumea 10 (1):261, 1960.

Erigeron molle D. Don, Prodr. 172, 1825.

B. wightiana DC. in Wight Contrib. 14, 1834; FBI 3:26; Cooke, T. 2: 19 (2:75).

Rare species at Mahabaleshwar near Lingmala.

FLOWERS: December-January.

8. **Blumea oxyodonta** DC. in Wight Contrib. Bot. Ind. 15, 1834; FBI 3:266; Cooke, T. 2:21 (2:77); Randeria Blumea, 10 (1):280, 1960, Puri & Mahajan, 125.

Rare species at Mahabaleshwar. Only known from a single collection.

FLOWERS: March.

9. **Blumea virens** DC. in Wight, Contrib. Bot. Ind. 14, 1834; FBI 3:264; Cooke, T. 2: 21 (2:77); Randeria, Blumea 10 (1):272, 1960.

Rare species.

FLOWERS: May-June.

Caesulia Roxb.

1. **Caesulia axillaris** Roxb., Pl. Cor. 1:64, t. 93, 1795; Graham, 96; Dalz. Gibs. 126; Wight, Icon. t. 1102; FBI 3: 291; Cooke, T. 2:35 (2:92); Puri & Mahajan, 125.

Rare species at Mahabaleshwar, in damp places and in ricefields.

FLOWERS: August-May.

Calendula Linn.

1. **Calendula officinalis** Linn., Sp. Pl. 921, 1753; Graham, 101; Dalz. & Gibs. suppl. 48; Cooke, T. 2:68 (2:126); Bot. Mag. t. 3204, Birdwood, 17.

Cultivated garden plant frequently grown in private gardens.

FLOWERS: Throughout the year.

Carthamus Linn.

1. **Carthamus tinctorius** Linn., Sp. Pl. 830, 1753; Graham, 95; Dalz. & Gibs. suppl. 45; Cooke, T. 2:68 (2:126-7).

Frequently cultivated for its oil seed.

FLOWERS: March-May.
LOCAL NAME: Kusumba.

Centrantherum Cass.

1. Achenes deeply ribbed ....*C. phyllolaenum*
1. Achenes faintly ribbed ....*C. lilacinum*

1. **Centratherum lilacinum** (Dalz. & Gibs.) comb. nov.

Decaneuron lilacinum Dalz. & Gibs., Bombay Fl. 314, 1861;
C. tenue (Wight) Clarke, Comp. Ind. 4:1876; FBI 3:228;
Cooke, T. 650 & 2:7 (2: 63);** Lee, 634; Birdwood, 16;
Puri & Mahajan, 125; Santapau, 122.
C. molle Benth. var. *tenui* Wight *ex* Clarke, Comp. Ind. 4, 1876 (as synonym).

Rare species at Mahabaleshwar near Arthur's Seat, and along the Fitzgerald Ghat.

FLOWERS: October-November.

*2. **Centratherum phyllolaenum** (DC.) Benth. *ex* Clarke, Comp. Ind. 4:1876; FBI 3:228; Cooke, T. 2:7 (2:62); Birdwood, 16; Dalz. & Gibs. 667; Puri & Mahajan, 125.

Decaneuron phyllolaenum DC. Prodr. 7:264, 1838.
D. molle Dalz. & Gibs., Bombay Fl. 122, 1861 (non DC., 1838).

Common herb in partially shaded places along margins of forests and along roadsides.

FLOWERS: August-October.

Conyza Less.

1. Leaves linear to spathulate; achenes puberulous .... *C. stricta*
1. Leaves lanceolate; achenes glabrous *C. viscidula*

2. **Conyza stricta** Willd., Sp. Pl. 3: 1922, 1804; FBI 3:258; Birdwood, 16; Cooke, T. 650 & 2:17 (2:73); Puri & Mahajan, 125; Santapau 401, 1962.

C. absinthifolia DC. in Wight, Contr. 16, 1834; Graham, 97; Dalz. & Gibs. 124; Lee, 635.
C. adenocarpa Dalz. & Gibs., Bombay Fl. 125, 1861; FBI 3: 259.

Frequent herb on loose sandy soil with yellowish white flowers.

LOCALITIES: Lodwick Point, Tiger Path, Lingmala, Kate's Point, Wada and Petit road.

FLOWERS: October-December.

2. **Conyza viscidula** Wall. ex DC., Prodr. 5: 383, 1834; Clarke, Comp. Ind. 63, 1876; FBI 3:258.

Quite frequent, much branched herb along forest borders.

LOCALITIES: Fitzgerald Ghat, Chinaman's Falls, Bhilar Estate, near Pratapsing Park.

FLOWERS: December-January.

Cyathocline Cass.

1. **Cyathocline purpurea** (Don) O. Kuntze, Rev. Gen. Pl. 338, 1891; Puri & Mahajan, 125.

Tanacetum purpureum Don, Prodr. Fl. Nepal. 181, 1825.
C. lyrata Cass. in Ann. Soc. Sci. Nat. ser. 1, 17: 420, 1829; Wight, Icon. t. 1098; FBI 3: 246; Birdwood, Cooke, T. 2:15 (2:71).

Common and abundant herb in semi-shaded places and along water courses. It is also quite common in ricefields after the harvests.

**Major H. H. Lee, Apendex A — List of Mahabaleshwar Plants, in Bombay Gazetteer Vol. 19 (Satara), pp. 625-646, 1885.

* Recently all our specimens of this species sent to L. K. Kirkman, University of Georgia Herbarium have been identified by her as *Phyllocephalum scabridum* (DC. in Wight) Kirkman.

LOCALITIES: Chinaman's Falls, Dhobi's Falls, Madhu Kosh.

FLOWERS: September-March.
LOCAL NAME: Gangotra.

Dichrocephala DC.

1. **Dichrocephala integrifolia** (Linn. f.) O. Kuntze, Rev. Gen. Pl. 333, 1891; Hara, Fl. East Himal. 338, 1966.

Hippia integrifolia DC. in Wight, Contrib. 11, 1834; Dalz. & Gibs. 124; Wight, Icon t. 1096; Birdwood, 16; Cooke, T. 650 & 2:14 (2:70); Puri & Mahajan, 125; Santapau, 292, 1963.

Common and abundant weed all over in wastelands and along roadsides. Plants are very variable in size and in the nature of pubescence. Mahabaleshwar plants show both glabrous as well as densely pubescent nature. In fact Rev. Fr. Santapau had separated pubescent forms of this species and kept them in a separate folder under the name *D. tomentosa*, but to the best of our knowledge it has not been published.

LOCALITIES: Chinaman's Falls, Dhobi's Falls, Yenna Lake, Petit Road, Madhu Kosh, Satara Road, Market.

FLOWERS: May-October.

Echinops Linn.

1. **Echinops echinatus** Roxb., Fl. Ind. 3:447, 1832; Graham, 95; Dalz. & Gibs., 131; FBI 3:358; Cooke, T. 2:54 (2:112); Puri & Mahajan, 126.

Common herb on arid dry land.

FLOWERS: February.

Eclipta Linn. (nom. cons.)

1. **Eclipta alba** (Linn.) Hassk., Pl. Jav. Rar. 528, 1848; Dalz. & Gibs. 117; FBI 3:304; Santapau, in Rec. Bot. Surv. Ind. 150, 1953; T. P. Ramamoorthy, in Fl. Hassan Dist. 612, 1976.

Verbesina alba Linn. Sp. Pl. 902, 1753;
E. prostrata (Linn.) Linn., Mant. 2:286, 1771; Graham, 99; Dalz. & Gibs. 127; Santapau in J. Bombay nat. Hist. Soc. 54: 475, 1957.
V. prostrata Linn., Sp. Pl. 902, 1753.

Common gregarious herb in moist places. It is also found as a weed among the grasses in cultivated fields and in gardens.

FLOWERS: Throughout the year.
LOCAL NAME: Maka, Bhangra.

Elephantopus Linn.

1. **Elephantopus scaber** Linn., Sp. Pl. 814, 1753; Graham, 96; Wight, Icon. t. 1086; FBI 3:242; Lee 634; Cooke, t. 2:12 (2:68).

Rare herb in shady places.

FLOWERS: September-December.

Erigeron Linn.

1. **Erigeron karvinskianum** DC., Prodr. 5: 285, 1836; Santapau, 126.

Common along the hedges from Ripon Hotel to Bus stand. Also common weed near racecourse. Probably it is an escape from cultivation.

FLOWERS: November-March.

Eupatorium Linn.

1. **Eupatorium glandulosum** H. B. K., Nov. Gen. & Sp. 4:122, 1820 & Bot. Reg. t. 1723, 1834; Bot. Mag. t. 8139, 1907.

E. adenophorum Spreng., Syst. 2:420, 1826; Koster, in Blumea 1(3): 502, 1935.

Common herb near water courses, in fields and on forest fringes. Flowers pure white.

Koster, in Blumea (1. c.) puts *E. glandulosum* H.B.K. in synonymy of *E. adenophorum* Spreng. But *E. glandulosum* H.B.K. is the earlier and the correct name for this species.

FLOWERS: March-April.
LOCALITIES: Chinaman's Falls, Yenna Lake, Goatweed, Mexican white Floss Flower.

Galinsoga Ruiz & Pavon

1. Leaves with non-ciliate and dentate margins .... *G. parviflora*
1. Leaves with ciliate and serrate margins....... .... *G. ciliata*

1. **Galinsoga ciliata** (Raf.) Blake, in Rhodora, 24:35, 1922.

Adventina ciliata Raf., New Fl. N. Amer. 1:67, 1936.
G. parviflora var. *hispida* DC., Prodr. 5:677, 1836. (non G. hispida Benth., 1844).

Common weed in cultivated fields and in gardens.

FLOWERS: September-April.
LOCALITIES: Tiger Path, Lingmala, Bhilar Estate, Yenna Lake, Petit Road.

2. **Galinsoga parviflora** Cav., Ic. Descr. Pl. 3:41, t. 281, 1795; Clarke, Comp. Ind. 112, 1876; FBI 3:311.

An American weed in cultivated lands and in waste places. Abundant especially on the sides of irrigation canals.

LOCALITIES: Chinaman's Falls, Tiger Path, Madhu Kosh, Bhilar Estate.
FLOWERS: August-May.

Gnaphalium Linn.

1. Heads in leafy spikes; plants less than 15 cm tall .... *G. polycaulon*
1. Heads in corymbs; plants more than 20 cm. tall .... *G. luteo-album*

1. **Gnaphalium luteo-album** Linn., Sp. Pl. 851, 1753; FBI 3:288; Birdwood, 16; Cooke, T. 650 & 2:30 (2:86).

Common erect herb in wet places and near the lake. Flowers heads golden yellow.

FLOWERS: March-June.

2. **Gnaphalium polycaulon** Persoon, Syn. 2: 421, 1807; T. P. Ramamoorty in Fl. Hassan Dist. 616, 1976.

G. indicum auct. (*non* Linn., 1753); Dalz. & Gibs. 130, 1861; FBI 3:289; Cooke, T. 2:30 (2:87); Puri & Mahajan, 125.

Prostrate herb abundant in moist soils near lake and in wet places. Branches radiating on ground.

FLOWERS: October-December.

Guizotia Cass. (nom. cons.)

1. **Guizotia abysinica** (Linn. f.) Cass., Dict. Sci. Nat. 59: 248, 1829; FBI 3:308; Cooke, T. 2:66 (2:125).

Polymnia abysinica Linn. f. suppl. 383, 1781.
G. oleifera DC., Prodr. 5:551, 1834; Dalz. & Gibs. 128.

Cultivated for oil seeds. Occasionally found in wild as an escape from cultivation.

FLOWERS: October-January.
LOCAL NAMES: Til, Ramtil, Kala Til.

Gynura Cass.

1. **Gynura cusimbua** (D. Don) S. Moore in Journ. Bot. 50:212, 1912; Santapau, Fl. Khandala, ed. 3, 134, 1967.

Cacalia cusimbua D. Don, Prodr. Fl. Nepal. 179, 1825.
G. angulosa DC., Prodr. 6:298, 1837; Clarke, 170; FBI 3:334; Cooke, T. 2:49 (2:106); Puri & Mahajan, 125.
G. simplex Dalz. & Gibs. Bombay Fl. 130, 1861; Cooke, T. 650, 1885.
G. nitida Woodrow in J. Bombay nat. Hist. Soc. 11:650, 1898 (*non* DC., 1837).

Common along Fitzgerald Ghat and along the edges of forests, but nowhere abundant.

FLOWERS: September-November.

Helianthus Linn.

1. **Helianthus annus** Linn., Sp. Pl. 904, 1753; Graham, 100; Cooke, T. 2:66 (2:124).

Very common in gardens as an ornamental plant. Rarely cultivated on large scale for oil seeds.

FLOWERS: Throughout the year.
LOCAL NAME: Surya phul.

Lactuca Linn.

1. **Lactuca sativa** Linn. Sp. Pl. 795, 1753; Maheshwari, Fl. Delhi, 188-9, 1976.

L. scariola Linn. var. *sativa* (Linn.) Hook. f. in Fl. Brit. India 3:404; Cooke; T. 2:61 (2:119).

Cultivated vegetable plant. Leaves used as salad.

FLOWERS & FRUITS: October-March.
LOCAL NAMES: Lettuce, Salad.

Birdwood, in his catalogue (p. 16), has included *Lactuca heyneana* DC., but subsequently this species has not been collected by any collector and there is no authentic specimen in any herbarium.

Lamprachenium Benth.

1. **Lamprachenium microcephalum** (Dalz.) Benth. in Benth. & Hook. f. Gen. Pl. 2:226, 1873; FBI 3:229; Lee, 634; Birdwood, 16; Cooke, T. 650 & 2:8 (2:64); Puri & Mahajan, 125.

Decaneuron microcephalum Dalz., in Kew Journ. Bot. 3: 231, 1851; Dalz. & Gibs. 122.

Common herb along hedges and in wastelands.

FLOWERS: December.
LOCAL NAME: Bramhmadandi.

Notonia DC.

1. **Notonia grandiflora** DC., Wight, Contr. 24, 1834; Dalz. & Gibs. 132; Markham, 386; Birdwood, 16; Cooke, T. 2:50 (2:107).

N. corymbosa DC., Prodr. 6:442, 1837.
N. balsamina Dalz. & Gibs., Bombay Fl. 133, 1861.

It is very common species along Khandala Ghat near Wai. But we have not seen it on Mahabaleshwar plateau or Mahad Ghat.

FLOWERS: September-November.
LOCAL NAME: Vander roti.

Parthenium Linn.

Parthenium hysterophorus Linn., Sp. Pl. 988, 1753; R. S. Rao, in J. Bombay nat. Hist. Soc. 54: 218-20, t. 1, 1956.

American weed gradually spreading in grasslands and in open wastelands.

FLOWERS: July-December.
LOCAL NAMES: Congress gavat.

Senecio Linn.

1. Heads ebracteolate; pappus absent .... *S. belgaumensis*
1. Heads bracteolate; pappus present 2
    2. Pappus hairy, slender .... *S. dalzellii*
    2. Pappus paleaceous .... *S. grahami*

1. **Senecio belgaumensis** (Wight) C. B. Clarke, Comp. Ind. 200, 1876; FBI 3:348; Birdwood, 17; Cooke, T. 2:53 (2:111); Puri & Mahajan, 125.

Madacarpus belgaumensis Wight, in Calcutta Journ. nat. Hist. 7:157, 1847; Wight, Icon. t. 1152; Dalz. & Gibs. 130; Birdwood, 17.

Rare herb at Mahabaleshwar.

FLOWERS: August-January.
LOCAL NAME: Sonki.

2. **Senecio dalzellii** C. B. Clarke, Comp. Ind. 201, 1876; FBI 3:346; Birdwood, 17; Cooke, T. 2:52 (2:110).

S. lawii C. B. Clarke, Comp. Ind. 201, 1876.

Reported here on the authority of Birdwood.

FLOWERS: November-December.

3. **Senecio grahami** Hook. f. in Flora Brit. India 3:347, 1881; Birdwood, 17; Cooke, T. 650 & 2:52 (2:110); Puri & Mahajan, 125; Santapau, 400, 1962 & 293, 1963.

S. reticulata Clarke, Comp. Ind. 199, 1876. (non DC., 1834).

Doronicum reticulatum Wight, Cal. Journ. nat. Hist. 7:156, 1847; Wight, Icon. t. 1151B; Dalz & Gibs. 130.

Common and abundant herb in open grasslands.

FLOWERS: August-December.
LOCAL NAME: Sonki.

Sonchus Linn.

1. **Sonchus asper** (Linn.) Garsault, Fig. Pl. Anim. Med. 4:332, t. 565, 1767; FBI 3: 414; Graham, 94; Cooke, T. 2:61 (2:120).

S. oleraceus var. *asper* Linn. sp. Pl. 794, 1753.

Rare plant near Lingmala falls on earth banks.

FLOWERS: January-March.
LOCAL NAME: Mhatara.

Spilanthes Linn.

1. **Spilanthes paniculata** Wall. ex DC., Prodr. 5:625, 1834.

S. acmella auct. (*non* [Linn.] Murr., 1774); Graham, Cat. Bombay Pl. 99, 1839; Dalz. & Gibs. 129; FBI 3:307; Birdwood, 16; Cooke, T. 650 & 2:42 (2:99); Puri & Mahajan, 125.

S. calva Wight, Icon. t. 1109, 1846 (*non* DC., 1834).

Suberect herb along sides of streams and lake. Quite common in wet ricefields after harvests. Leaves on chewing cause numbness of tongue followed by profuse salivation.

FLOWERS: December.
LOCAL NAME: Akkalkara.

Synedrela Gaertn.

1. **Synedrela nodiflora** (Linn.) Gaertn. Fruct. 2:456, t. 171, f. 7, 1791.

Verbesina nodiflora Linn. Cent. Pl. 1:28, 1755, Amoem. Acad. 4:290, 1759.

A tropical American weed growing in cultivated and wastelands.

FLOWERS: November.

Tricholepis DC.

1. Pappus absent or rarely of few hairs.......... .... *T. amplexicaulis*
1. Pappus rigid, sub-paleaceous .... *T. glaberrima*

1. **Tricholepis amplexicaulis** C. B. Clarke, Comp. Ind. 240, 1876; FBI 3:281; Cooke, T. 2:51 (2:115); Puri & Mahajan, 126.

This is not a common plant but found in patches at Elphinston Point.

FLOWERS: December.
LOCAL NAME: Dahan.

2. **Tricholepis glaberrima** DC. Prodr. 6: 754, 1837; Dalz. & Gibs. 131; FBI 3:381; Lee, 635; Birdwood, 17; Cooke, T. 650 & 2:56 (2:114); Puri & Mahajan, 126.

Serratula indica Willd. Sp. Pl. 3:1642, 1804; Graham, 95.

Frequent herb among the grasses in open grasslands.

FLOWERS: October.
LOCAL NAME: Dahan.

Tridax Linn.

1. **Tridax procumbens** Linn., Sp. Pl. 900, 1753; FBI 3:311; Birdwood, 16; Cooke, T. 2:45 (2:102); Puri & Mahajan, 125.

A South American weed naturalized and growing everywhere in wastelands and in gardens.

FLOWERS: Throughout the year.
LOCAL NAME: Pathri.

Vernonia Schreb.

1. Achenes pubescent or silky.......... *V. cineria*
1. Achenes glabrous or glandular...............2
    2. Leaves thin, membranaceous, not tomentose .... *V. divergens*
    2. Leaves thick, coriaceous, densely wooly tomentose beneath .... *V. indica*

1. **Vernonia cineria** Less. in Linnaea 4: 291, 1829; Graham, 96; Dalz. & Gibs. 121; FBI 3: 233; Birdwood, 16.

Conyza cineria Linn. Sp. Pl. 862, 1753.

Frequent on the lower slopes of the Ghat roads.

FLOWERS: Throughout the year.

LOCAL NAMES: Sahadevi, Moti sadori.

2. **Vernonia divergens** (Roxb.) Edg. in Journ. Asiat. Soc. Bengal 21:172, 1853; FBI 3:234; Lisboa, 216; Cooke, T. 650 & 2:11 (2:67); Puri & Mahajan, 125.

Eupatorium divergens Roxb., Fl. Ind. 3:414, 1832; Dalz. & Gibs. 123.

Decaneuron divergens DC., Prodr. 5: 68, 1836; Wight, Icon. t. 1084.

Rare undershrub along the edges of the forests.

FLOWERS: December-March.

LOCAL NAMES: Bundar, Bondar.

3. **Vernonia indica** C.B. Clarke, Comp. Ind. 16, 1876; Lisboa, 216; FBI 3:238; Cooke, T. 2:11 (2:67); Puri & Mahajan, 125.

Decaneuron dendigulense DC., in Wight, Contrib. Bot. Ind. 7, 1834 non *Vernonia dendigulense* DC., 1838).

This species included here on authority of Puri and Mahajan.

Vicoa Cass.

1. **Vicoa cernua** Dalz. in Dalz. & Gibs. Bombay Fl. 126 & 314, 1861; FBI 3:297; Birdwood, 16; Lee, 635; Cooke, T. 650 & 2:32 (2:89); Puri & Mahajan, 125.

Rare herb among grasses in partially shaded places and along the margins of forests.

FLOWERS: October-January.

Wedelia Jacq. (nom. cons.)

1. **Wedelia urticaefolia** (Bl.) DC. in Wight Contrib. 18, 1834; Wight, Icon. t. 1106; FBI 3:306; Birdwood, 16; Cooke, T. 2:41 (2:98).

Wollastomia biflora Dalz. & Gibs., Bombay Fl. 128, 1861 (Excl. syn., *non* DC., 1834).

Verbesina biflora Wall. *ex* Graham, Cat. Bombay Pl. 100, 1839.

V. urticaefolia Blume, Bijdr. 911, 1825.

Rare undershrub in shady places among the undergrowths near the margins of the forests.

FLOWERS: August-September.

Xanthium Linn.

1. **Xanthium strumarium** Linn., Sp. Pl. 987, 1753; FBI 3:303; Cooke T. 2:37 (2:94).

X. indicum Koen. ex Roxb., Fl. Ind. 3:601, 1832; Graham, 101; Dalz. & Gibs. 127; Wight, Icon. t. 1104.

Rare weed in wastelands.

FLOWERS & FRUITS: September-April.

LOBELIACEAE

Lobelia Linn.

1. Erect stout herbs; flowers in terminal racemes .... *L. nicotinaefolia*
1. Prostrate or procumbent herbs; flowers axillary, solitary 2
    2. Stems not winged .... *L. alsinoides*
    2. Stems winged .... *L. heyneana*

1. **Lobelia alsinoides** Lamk., Encycl. 3: 588, 1791; Santapau, Fl. Khandala, ed. 3, 140.

L. trigona Roxb., Fl. Ind. 2:111, 1824; FBI 3: 423; Dalz. & Gibs. 133; Wight, Icon. t. 1170; Cooke, T. 2:72 (2:130).

Birdwood, 17; Puri & Mahajan, 126.

Common weed in moist places and in drying ricefields.

FLOWERS: September-March.

2. **Lobelia heyneana** Roem. & Schultz. Syst. 5:50, 1819, Santapau, 139.

L. trialata Buch.-Ham. in D. Don, Prodr. 157, 1825; Birdwood, 17, FBI 3: 425; Woodrow, in Journ. Bombay nat. Hist. Soc. 12: 162, 1898; Cooke, T. 2:72 (2:130); Puri & Mahajan, 126.

Frequent herb on earth clearings along roadsides.

FLOWERS: August-October.

3. **Lobelia nicotinaefolia** Heyne ex Roth., Nov. Sp. Pl. 143, 1821; Graham, 102; Dalz. & Gibs. 133; FBI 3:427; Birdwood, 17; Cooke, T. 2:72 (2:131); Puri & Mahajan, 126.

Very common herb. Often gregarious on open grassy slopes along the edges of the forests. A very distinct and attractive plant conspicuous by the masses of white flowers in long terminal spikes, above the dense foliage.

FLOWERS: October-April; FRUITS: November-April.

LOCAL NAMES: Devnal, Bokenal, Dhaval.

CAMPANULACEAE

1. Capsules loculicidally dehiscent within the calyx-teeth 2
   2. Corolla rotate, lobes linear; stigma capitate .... *Cephalostigma*
   2. Corolla campanulate, lobes short and broad; stigma lobed .... *Wahlenbergia*
1. Capsule dehiscing at the base or on sides below the calyx teeth .... *Campanula*

Campanula Linn.

1. Flowers dimorphic; corolla 5-6 mm long .... *C. cordata*
1. Flowers all similar; corolla 10-13 mm long.... .... *C. alphonsii*

1. **Campanula alphonsii** Wall. ex DC., Prodr. 7:473, 1837; FBI 3:440; Wight, Icon. t. 1177; Cooke, T. 2:76 (2:134); V. D. Vartak, J. Univ. Poona, 10:8, 1957.

A rare species. Only collected from a vertical rock near Kate's Point.

FLOWERS: October.

2. **Campanula cordata** Wall. ex Roxb., Fl. Ind. Carey ed., 2: 101, 1832; Rao, in Bull. Bot. Surv. India, 10 (suppl. 2): 45, 1969.

C. canescens Wall., DC., Prodr. 7:473, 1837; FBI 3:439; Santapau, in Journ. Bombay nat. Hist. Soc. 45: 446, 1945.
446; 1945.

Cephalostigma spathulatum Thwaites, Enum. 422, 1859.

Rare slender herb, found on moist beds of streams in wet soils. Collected from Lingmala and Old Mahabaleshwar only.

FLOWERS & FRUITS: November-December.

Cephalostigma DC.

1. Stems erect; leaves oblong .... *C. erecta*
1. Stems flexuose; leaves broadly ovate.......... .... *C. flexuosa*

1. **Cephalostigma erecta** (Roth ex. R. & S.) Vatke in Linnaea, 38: 699, 1874.

Dentella erectum Roth, ex Roem. & Schultes, Syst. Veg. 5:25, 1819.

C. schimperi Hochst. ex Rich., Tent. Abyss. 2: 2, 1851.

Wahlenbergia perfoliata Wight & Arn., in Prodr. 405, 1834; Wight, Icon. t. 842, 1844.

C. hirsutum Hk. f. & Thomson, in Journ. Linn. Soc. 2:9, 1858 (p. p.); Dalzell & Gibs. 133 (non Edgew., 1851).

Rare species, only collected from Bhilar Estate.

FLOWERS: November.

2. **Cephalostigma flexuosa** Hk. f. & Thomson in Journ. Linn. Soc. 2:9, 1858; Cooke, T. 650 (Bombay Gazette).

This species is reported here on the authority of T. Cooke only. Although he reports it in the earlier publication he does not repeat its occurrence at Mahabaleshwar in Flora of Bombay Presidency later.

Wahlenbergia Schrad.

1. **Wahlenbergia marginata** (Thunb.) DC., Monog. Campan. 143, 1830; Santapau, 140.

Campanula marginata Thunb., Fl. Japan, 89, 1784.
C. dehiscens Roxb., Fl. Ind. 1:504, 1832; Graham, 103.
W. gracilis Schrad., Blumea 38, 1827; FBI 3:429; Cooke, T. 650 & 2:74 (2:133).
W. agrestis DC., Prodr. 7: 434, 1836; Dalz. & Gibs. 134; Wight, Icon t. 1175.

Common in moist grounds near Yenna Lake and near streams and in ricefields.

FLOWERS AND FRUITS: December-May.

PLUMBAGINACEAE

Plumbago Linn.

1. Flowers white or blue 2
  2. Calyx covered with stalked glands all over .... *P. zeylanica*
  2. Calyx glandular in the upper part only..... .... *P. auriculata*
1. Flowers red .... *P. indica*

1. **Plumbago auriculata** Lamk., Encycl. 2:270, 1786; Degener, in Fl. Hawai. fam. 292, 1946.

P. capensis Thunb., Prodr. Capen. 33, 1794; Graham, 166; Dalz. & Gibs. suppl. 72; Cooke, T. 2: 78 (2:137).

Cultivated garden plant with pale blue flowers grown as ornamental plant.

FLOWERS: May-December.
LOCAL NAME: Nila chitrak.

2. **Plumbago indica** Linn. in Stickman Herb. Amb. 24, 1754; Merrill, Interpr. Rump. 414, 1917.

P. rosea Linn., Sp. Pl. ed. 2, 215, 1765; FBI 3: 481; Graham, 166; Cooke, T. 2: 78 (2:137).
P. coccinea Boiss. in DC. Prodr. 12:693, 1848; Dalz. & Gibs. suppl. 71.

An ornamental cultivated plant .

FLOWERS: Throughout the year.
LOCAL NAME: Lal chitrak.

3. **Plumbago zeylanica** Linn., Sp. Pl. 151, 1753; Graham, 166; Dalz. & Gibs. 220; Wight Ill. t. 179; Cooke, T. 2:78 (2:136-7).

Rare perennial herb along the edges of the forests, in white flowers. Sometimes seen in cultivations and in gardens.

FLOWERS: August-September.
LOCAL NAMES: Chitrak, Safed chitrak.

PRIMULACEAE

Anagallis Linn.

1. Leaves alternate; flowers white ...... *A. pumila*
1. Leaves opposite; flowers blue ...... *A. arvensis*

1. **Anagallis arvensis** Linn., Sp. Pl. 148, 1753; FBI 3:506; Birdwood 17; Cooke, T. 2:80 (2: 139); 136; Maheshwari, Fl. Delhi, 203, 1976.

A. coerulea Lamk., Fl. Lips. 5: 1771.
A. arvensis Linn. var. *coerulea* (Lamk.) Gren. & Godr. Fl. Pr. 2: 467, 1852.

Rare herb at Fitzgerald Ghat, and in Yenna Valley.

FLOWERS: September-October.

2. **Anagallis pumila** Swartz, Prodr. Veg. Ind. Occ. 1: 40, 1788; Pax & Kunth, Pfreich. 22: 331, t. 71, 1905; Santapau, 401, 1962.

Centanculus tenellus Duby, in DC., Prodr. 8:72, 1844; FBI 3: 506; Cooke, T. 2:80 (2:140).
Micropyxis tenella Wight, Icon. t. 1585, 1850.

One of the most common and abundant herb among the grasses. Due to its smaller size it is generally hidden among the grasses and goes unnoticed in field studies.

FLOWERS & FRUITS: October-November.

Lysimachia obovata Ham. ex Hook. f. Flora Brit. Ind. 3: 503, 1881, has been reported by Lisboa (Climate of Mahabaleshwar, 1886). But subsequently nobody has collected this species from Mahabaleshwar. Probably an escape from cultivation.

(To be continued)

A CATALOGUE OF THE BIRDS IN THE COLLECTION OF THE BOMBAY NATURAL HISTORY SOCIETY — 26

MUSCICAPIDAE (Timaliinae) (contd.)

HUMAYUN ABDULALI

[*Continued from Vol. 79*(2): 360]

348 specimens of 45 species and subspecies (Nos. 1235 — 1271 in INDIAN HANDBOOK with 5 extra-limitals) are included. The last specimen in this group is Reg. no. 26086. Mr. Eric D'Cunha, Research Assistant, helped with the work.

1235 **Panurus biarmicus russicus** (Brehm) (Russia) Bearded Tit-Babbler

2: 1 ♂ 1 ♀ (?)

1 *Keriya, 4300'; Khotan, Sinkiang, China.*

Measurements on p. 615.

1236 **Conostoma aemodium** Hodgson (Nepal) Great Parrotbill 1:104

1 ♂ Dakuri, Kumaon, U.P.

Wing 126 (about 130 to 133 mm); bill 24 (culmen about 20 mm); tarsus 38.5 (about 37 mm); tail 128 (about 140 mm).

Measurements on p. 615.

1237 **Paradoxornis unicolor unicolor** (Hodgson) (the Cachar, Nepal) Brown Suthora Parrotbill 1:198

2: 1 ♂ 1 ♀

1 Bunthang, Bhutan; 1 Tongloo, nr. Darjeeling.

The female from Tongloo which goes back to the early part of the present century, is rufous, while the male (1973) is olive-brown above and marked with grey below.

Measurements on p. 615.

1238 **Paradoxornis fulvifrons fulvifrons** (Hodgson) (Nepal) Fulvousfronted Parrotbill

2: 1 ♂ 1 ♀ Sandakphu, Darjeeling

Measurements on p. 615.

1239 **Paradoxornis fulvifrons chayulensis** (Kinnear) (Lung, Chayul Valley, S.E. Tibet) Tibetan Fulvousfronted Parrotbill

nil.

1239a **Paradoxornis nipalensis garhwalensis** Fleming & Taylor (Kurumtoli, Garhwal, U.P.)

nil.

1240 **Paradoxornis nipalensis nipalensis** (Hodgson) (Nepal, restricted to Kathmandu Valley) Ashy-eared Parrotbill 1:109

nil.

1241 **Paradoxornis nipalensis humii** (Sharpe) (Darjeeling) Blackfronted Parrotbill 1:110

1 o? Shamgong, Central Bhutan.

The orange-yellow ear-coverts immediately separate it from all the others available.

Measurements on p. 615.

1242 **Paradoxornis nipalensis poliotis** (Blyth) (Cherrapunji, Khasi Hills) Assam Orange Parrotbill 1:109

4: 3 ♂♂ 1 ♀

1 ♂ Tezu, Lohit Valley, Upper Assam; 3 Miao, Tirap Div., Arunachal Pradesh.

The single ♂ from Tezu shows more orange-rufous and less olive on the upperparts than the other 3 from Miao. It has also a brighter yellow head. Dr. Ripley, who has also access to specimens from both places, writes that he cannot see any difference between them and I am leaving them together. The ♀ has the blackest chin.

Measurements on p. 615.

1243 **Paradoxornis nipalensis crocotius** Kinnear (Yonyu La, near Trashigong, E. Bhutan) Tibetan Small Parrotbill

nil.

1244 **Paradoxornis nipalensis patriciae** Koelz (Blue Mountain, Lushai Hills) Mizo Hills Parrotbill

nil.

1245 **Paradoxornis atrosupercilaris oatesi** (Sharpe) (Darjeeling) Lesser Redheaded Parrotbill 1:117

nil.

1246 **Paradoxornis atrosuperciliaris atrosuperciliaris** (Godwin-Austen) (Sadiya, Assam) Blackbrowed Parrotbill 1:114

3 ♂♂

1 Dening, Lohit Valley, N. E. Assam; 1 40th m. from Miao, Tirap Div., Arunachal Pradesh; 1 Cachar Hills.

In the bird from Dening, the rufous of the head and nape is darker.

Measurements on p. 615.

1247 **Paradoxornis ruficeps ruficeps** Blyth (Bootan) Greater Redheaded Parrotbill 1:116

5: 1 ♂ 4 ♀♀

1 Kurseong; 2 Tama, Central Bhutan; 1 Buxa Duars; 1 40 m. from Miao, Tirap Div., Arunachal Pradesh.

The ♂ from Tirap Div., shows no more buff on the underparts than the others and only differs in having no rufous in the olive-brown back, but may well be left with the nominate form.

Measurements on p. 616.

1248 **Paradoxornis ruficeps bakeri** (Hartert) Hungrum, N. Cachar) Assam Redheaded Parrotbill 1:117

3: 1♂ 1 ♀ 1 o?

2 Rema Tea Estate, Sylhet; 1 Rotung, Abor Hills 28°N, 95°E.

All three have pale buff underparts which may well pass for sullied white and their upperparts are also all differently coloured.

Measurements on p. 616.

1249 **Paradoxornis gularis gularis** (Bhutan) Greyheaded Parrotbill 1:118

2: 1 ♂ 1 ♀ Tama, C. Bhutan.

Measurements on p. 616.

1250 **Paradoxornis gularis transfluvialis** (Hartert) (Guillong, N. Cachar) Assam Greyheaded Parrotbill 1:118

1 ♀ Guillong, N. Cachar Hills.

The underparts are very fainty washed with buff and the upperparts slightly redder.

Measurements on p. 616.

1251 **Paradoxornis flavirostris flavirostris** Gould (Nepal) Gould's or Blackthroated Parrotbill 1:105

1 ♀ Hassemara, N. Lakhimpur, Upper Assam.

Measurements on p. 616.

1252 **Paradoxornis guttaticollis** David (Moupin, east Chwanben, China) Whitethroated Parrotbill 1:106

4: 1 ♂ 3 o?

2 *Chin Hills,* 1 *4000' Bambo* (?), 1 *N. Shan States, Burma.*

The two unsexed birds from the Chin Hills (1915) have very pale heads and worn feathers on the back.

Measurements on p. 616.

1253 **Turdoides caudatus huttoni** (Blyth) (Kandahar, Afghanistan) Afghan Babbler. 1:199

7: 4 ♂♂ 3♀♀

5 Deh-Jotegh, Sistan Delta, Iran; 1 Suran, 24 m. NE of Pahrah, 2800′, *Persian Baluchistan;* 1 *Sitani,* 28°19′*N,* 65°5′*E, Baluchistan.*

The distribution of this species has always been a little confusing, having been mixed up with *eclipes* in northwest India and *salvadori* in western Iran. Ticehurst, 1926, 'Birds of British Baluchistan' (JBNHS 31, p. 694) has given a detailed account of its distribution in Sind and on our western borders which appears to be correct.

Measurements on p. 616.

1253a **Turdoides caudatus eclipes** (Hume) (Peshawar) Northern Common Babbler

11: 5 ♂♂ 5 ♀♀ 1 o?

2 Peshawar, 5 Rawalpindi, 1 Campbellpur, 1 Jholar, Kala Chitta Hills, Salt Range, 1 South Waziristan, 1 Damdil, Waziristan.

See note on validity of this form, *JBNHS* Vol. 79(1): 199-200.

Measurements on p. 616.

1254 **Turdoides caudatus caudatus** (Dumont) (India) Common Babbler 1: 199

41: 27 ♂♂ 10 ♀♀ 4 o?

1 Phulji, Larkana, Sind; 1 Kashmor, Sind Frontier; 2 Bhung, Bahawalpur; 1 Lahore, 2 Patiala State near Kalka (Simla), 1 Simla, 2 Chandigarh, 1 Labru, 1 Jagadhri, Ambala, Punjab; 3 Delhi; 3 Bharatpur; 1 Phalodi, 2 Hamavas Lake, 1 Pali, Jodhpur, Rajasthan; 1 Kutch, 1 Rudra Mata, 3 Karirohar, 1 Chohri, Bachau dist., Kutch; 2 Dabka, Baroda, Gujarat; 1 Bhind, 1 Narwar Fort, Gwalior, 1 Jaithari, Bhopal, M.P.; 1 Nasik; 1 Goregaon, 1 Salsette, Bombay; 1 Dhond (Poona), Maharashtra. 1 Tirthamalai, Salem dist., 1 Manalur, Palni Range, T.N.; 2 Tirhut, Bihar.

There is considerable variation in the intensity of the colour of the upperparts but it has not been possible to localise the dark and/or pale form in any one area, both being found in the same place. Two from Bharatpur (1970) which are the most recent additions show a lot of grey on the upper and lower plumage. This has almost disappeared in another from the same place obtained in 1961. The illustration of *huttoni* in Blanford's ZOOLOGY OF PERSIA differs from the specimens in the same manner. An old undated skin from Kutch registered in 1907 is almost an albino.

Measurements on p. 616.

EL **Turdoides caudatus salvadori** (De Filippi) (Shiraz, Fars, Iran).

6: 4 ♂♂ 2 ♀♀

3 *Mishum, Persian Gulf;* 1 *Mand,* 1 *Persia,* 1 *Pusht-e-Kuh, Laristan, Persia.*

Measurements on p. 616.

EL **Turdoides caudatus theresae** (Meinertzhagen) (Baghdad)

11: 7 ♂♂ 3 ♀♀ 1 o?

5 *Tigris,* 1 *Kazimani,* 4 *Baghdad;* 1 *Bursa, Mesopotamia.*

These birds were first named *huttoni* but Ticehurst, Buxton and Cheesman in 1922 in 'Birds of Mesopotamia' (JBNHS 28, p. 396) said they were the same as nominate *caudatus* and the name *huttoni* which has been struck off from some of the labels was presumably done at this stage.

Later in 1930 Meinertzhagen described *theresae* presumably without reference to *salvadori,* and subsequent writers, e.g. Etchecopar (1970) and Deignan in Peter's CHECK-LIST (1964, 10, p. 332) have synonymised this with *salvadori.*

Neither of the original descriptions[1] is available but the specimens here are more heavily streaked and darker on the underparts, and

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[1] Both descriptions have since been seen and the statements made herein appear to be in order.

with larger bills and tarsi. Two of the specimens have the feathers of the forehead "squamated" as in *squamiceps* (*infra*) but are not large enough to be placed among them. The material available appears separable from *salvadori* and is for the moment listed apart.
Measurements on p. 616.

EL **Turdoides squamiceps muscatensis** de Schauensee & Ripley (As Sib, near Muscat, Oman).
3 o? *Muscat, Arabia.*
Measurements on p. 617.

EL **Turdoides squamiceps yemensis** (Neumann) (Between Sheikh Othman & Laheji)
1 o? *Randhar, Tanhat, Yemen, Arabia.*
In the absence of any nominate material the single specimen is separated in accordance with the distribution in Peter's CHECKLIST (1964, 10, p. 334)
Measurements on p. 617.

1255 **Turdoides earlei sonivius** (Koelz) (Khinjar Lake, Sind) Western Striated Babbler.
9: 6 ♂♂ 2 ♀♀ 1 o? (juv.)
1 Chak, 1 Sukkur, Sind; 1 Bahawal Nagar, Bahawalpur, 6 Jagadhri, Ambala, Punjab.
I cannot separate the two races by a paler/darker throat and the grouping has been done on a geographical basis. Two from Sukkur, Sind, have pale upperparts, but these go back to 1900 and 1915, though they are not the oldest. The juvenile from Jagdalpur is uniformly buff below, with a slightly darker chin, throat and upperbreast.
Measurements on p. 617.

1256 **Turdoides earlei earlei** (Blyth) (Vicinity of Calcutta) Striated Babbler. 1:197
10: 6 ♂♂ 3 ♀♀ 1 o?
1 Bulandshar, U.P., 1 Darbhanga, Bihar; 3 Mornai Tea Estate, Goalpara, 1 Gafaldhubi, N. Lakhimpur, Assam; 1 *Monywa*, 1 *Upper Burma;* 1 *Yebank, Henzada,* 1 *Shurdaung, Prome Dist., Burma.*
The three from Mornai Tea Estate, Goalpara, Assam, have darker chins and more heavily streaked upper breasts.
Measurements on p. 617.

EL **Turdoides altirostris** (Hartert) (Fao, southeast Iraq, at mouth of the Shattal Arab)
7: 2 ♂♂ 3 ♀♀ 2 o?
3 *Amara,* 3 *Basra,* 1 *Fao, Mesopotamia.*
The two sexed males are larger than the females and also greyer (Jan-Feb. *contra* March-October).
Two of the females from Fao and Amara are very rufous and appear very different, but have been marked *altirostris* by an earlier worker (Ticehurst?).

Both *squamiceps* and *altirostris* though correctly named on the original labels were registered with *caudatus*.
Measurements on p. 617.

1257 **Turdoides longirostris** (Hodgson) (Nepal) Slender-billed Babbler 1:202
2: 1 ♂ 1 o?
2 Mornai Tea Estate, Goalpara, Assam.
Measurements on p. 617.

1258 **Turdoides malcolmi** (Sykes) (Dukhun, Poona) Large Grey Babbler 1:200
24: 7 ♂♂ 14 ♀♀ 3 o?
4 Ambala, 1 Dhirpur, Punjab; 2 Delhi; 1 Jalor, Jodhpur, Rajasthan; 1 Gir Forest, 1 Cambay City, 1 Dabka, Baroda, Gujarat; 2 Saugor, C.P.; 1 Sakbada, Nasik, 2 Satara, Maharashtra; 3 Chumbum Valley, Kurnool dist., A.P.; 3 Kalianpur, Cawnpur, 2* Meerut, U.P. (*1 albino).
Sp. ♀ No. 1066 from Meerut is an albino with the primaries mostly brown. There is some variation in the intensity of the colour of the underparts, but these cannot be associated with place, sex or season.
Measurements on p. 617.

1259 **Turdoides subrufus subrufus** (Jerdon) (Manantoddy, Wynaad) Rufous Babbler 1:201

14: 11 ♂♂ 1 ♀ 2 o?

2 Molem, Goa, 1 Karwar, 2 Mercara, Coorg, 2 Billigirirangan Hills; 2 Belemane, Mysore; 1 Gudalur, 2 Cherambadi, Wynaad, Nilgiris; 1 Perumalai, Palni Hills; 1 Shevaroy Hills.

There is much variation in the extent of rufous on the underparts, and some are rufous and others with an olive tinge above. These differences are however scattered and if *hyperythrus* is separable by the richer rufous of the underparts, this can apply only to two specimens from Travancore, mentioned below.

Measurements on p. 617.

1260 **Turdoides subrufus hyperythrus** (Sharpe) (Madras, restricted to Palghat) Kerala Rufous Babbler

2 ♀♀ (1* juv.)

1* Thirumalai, 1 Thekadi, Travancore.

See remarks above.

Measurements on p. 617.

Turdoides striatus

As in other babblers, an examination of the material available from over the whole country indicates differences which have not yet been accepted. Attention is drawn to some of them below, and a more detailed examination will no doubt require either the description of new races or the acceptance of once described forms now treated as synonyms.

1261 **Turdoides striatus sindianus** (Ticehurst) (Karachi, Sind) Sind Jungle Babbler 1:193

23: 7 ♂♂ (1 juv.) 12 ♀♀ (3 juv.) 4 o?

1 Khipro, Thar & Parkar, 1 Katray Taluk, Sind; 1 Bhunj, Bahawalpur, 1 Mubarikpur, near Ambala, 3 Ambala, 3 Simla, 1 Bhimtal, Kumaon; 3 Bharatpur, 1 Khara Ghoda, 1 Ganganar, Palanpur, 1 Jamnagar, 2 Dabka, 1 Bodeli, Baroda; 1 Dohad, 1 Vallabh-Vidyanagar, Anand; 1 Ramgarh, Jaipur.

Measurements on p. 618.

1262 **Turdoides striatus orientalis** (Jerdon) (Jungles of Carnatic & Eastern Ghats restricted to Horsleykonda, west of Nellore) Peninsular Jungle Babbler. 1:191 (part)

This was described as "Lighter than *malabaricus* especially beneath, where almost white, upper breast marked". In *Indian Handbook* (6, p. 227) this form is said to extend across India through Madhya Pradesh and southwards in peninsular India. The birds from the Eastern Ghats agree very well with the original description but not with those westwards which though marked *orientalis* by Salim Ali have their breast more heavily marked and darker underparts tinged with rufous. The birds from Mysore were also named *orientalis* by Sálim Ali (JBNHS 43, p. 318) but none of the seven specimens then listed is now available in Bombay. We have six more from Mysore but they appear neither *orientalis* nor *malabaricus*, and though perhaps nearer to the latter are listed here. To my mind there are at least three separate populations but I am for the moment leaving them under *orientalis* but separately.

(a) Nominate *orientalis* 13: 9 ♂♂ 3 ♀♀ 1 o?

2 Kurumbapatti, 1 Shevaroy Hills, 5 Chitteri Range, Salem dist.; 2 Kaduru, 2 Palkonda Hills, S. Cuddapah, 1 Nallamalai Range.

Measurements on p. 618.

(b) 17: 6 ♂♂ 10 ♀♀ 1 o?

1 Mathar, Bhopal, Narbadda Valley; 2 Pili, Melghat, 1 N. Chaurakund, Amraoti, Berar; 2 Jubbulpore, 1 Gondia; 2 Bhopalapatnam, 2 Darba, 2 Golapalli, 1 Amraoti, 1 Chota Dongar, 1 Lohattar Reserve Forest, Bastar; 1 Bhanupratapur, Kanker.

The first four westernmost birds have pale underparts, showing a tendency towards *sindianus* in the northwest. The others have more heavily marked breasts and darker underparts tinged with rufous.

These birds average slightly larger than those under (a).

Measurements on p. 618.

(c) 6: 4 ♂♂ 2 ♀♀

3 Ulair, 1 Bilimani, 1 Talaguppa, Sagar, 1 Gomatghatta, Shimoga, Mysore.

These birds have the streaking restricted to the upper breast and the lower parts show more rufous than in both (b) above and *malabaricus* below.

Measurements on p. 618.

1263 **Turdoides striatus somervillei** (Sykes) (Ghauts = Bombay Ghats) Bombay Jungle Babbler. 1:197

The original Latin description by Sykes as translated by Jerdon reads "reddish brown; abdomen, vent, lower back and tail light rufous, the latter obsoletely banded with darker; quills brown; the feathers of the throat and breast marked in the middle with blueish .....found in the Ghauts only".

It has been customary to accept all the birds from western India, from the Surat Dangs to South Karwar, in N. Kanara from both the Ghats and the low country to the west as *somervillei*, separable from the other races by the preponderance of rufous all over, particularly on the tail. When the forty specimens of this subspecies were laid on their backs in accordance with their geographical distribution, those from the Ghats, i.e. Suriamal (2), Bhimashankar (1) and Khandala (4) could be immediately separated by the bluish tinge on the feathers at the middle of the upper breast, and the almost black outer primaries. This does not appear to have been referred to in subsequent literature. Those from the low country though more rufous than any of the other races described, do not have these characters, nor did several glassed near Bombay. The birds from Ratnagiri are the most rufous all over, but some of them were collected as far back as 1878, and may have foxed. Here the primaries are dark brown and there are large buff spots on the upper breast.

Southwards, the rufous on the underparts deepens and in the birds from N. Kanara and Goa, the buff spots on the breast have narrowed to streaks and almost merged into the background.

The "ghat" and N. Kanara birds are separately listed but I am leaving them all under the same name until there has been an opportunity to compare freshly collected series from different places.

a) *somervillei* 7: 3 ♂♂ 3 ♀♀ 1 o?

2 Suriamal, Thana; 1 Bhimashankar, 4 Khandala, Poona,

(b) 33: 24 ♂♂ 8 ♀♀ 1 o?

1 Mahal, 1 Malegaon, 2 Waghai, Surat Dangs; 1 Borivli, 1 Marol, 2 Andheri, 3 Bandra, Salsette; 1 Mumbra, 1 Mumbra -Taloja Rd., Thana; 2 Mahabaleshwar, Satara Dist. 1 South Konkan, 3 Rajapur, 1 Dorli, 4 Ratnagiri; 2 Molem, 1 Goa; 1 Alanki, 1 Kumta, 4 Karwar, N. Kanara.

Measurements on p. 618.

1264 **Turdoides striatus malabaricus** (Jerdon) (Travancore & forests of Malabar) Malabar Jungle Babbler 1:192

13: 5 ♂♂ 7 ♀♀ 1 o?

4 Nilambur Valley; 1 Thattakad, N. Travancore, 1 Changanur, Edanad, 3 Tenmalai, C. Travancore; 1 Nilgiris; 1 Palnis; 2 Shenemenalla, Coimbatore dist.

The breast is strongly marked with whitish buff streaks on a dark background. The streaks continue further down than in any of the others. Except for No. 942 from Thattakad, N. Travancore, the others show no trace of rufous above or below.

See notes on Mysore birds under 1262

Measurements on p. 618.

1264a **Turdoides striatus orissae** (Jerdon) (Neotype Barkot, Bamra, Sambalpur, Orissa) Orissa Jungle Babbler

6: 2 ♂♂ 4 ♀♀

1 Anantgiri, Vizagapatnam; 1 Tikarpara, 1 Tigeria, 1 Barkot, 1 Badrama, Bamra, Sambalpur, 1 Barkul, Chilka Lake.

These are uniformly pale rufous below with the throat and upper breast very faintly marked.

Measurements on p. 619.

1265 **Turdoides striatus striatus** (Dumont) (Bengal) Bengal Jungle Babbler 1:191

8: 2 ♂♂ 6 ♀♀

1 Sameli, W. Bhutan; 3 Cawnpore, 1 Bijnor, U.P. 1 Kishenganj, 1 Baghowni, Behar; 1 24-Parganas, Bengal.

The feather shafts of the breast show up as streaks which is probably the origin of the name. There is a varying amount of grey and/or rufous on the upper and underparts but the absence of any striking differences and with no series from any place, there is no option but to leave them all together.

Measurements on p. 619.

1266 **Turdoides rufescens** (Blyth) (Ceylon) Ceylon Rufous Babbler 1:195

3: 1 ♂ 2 ♀♀

1 Karpoogalla, Pundalaya, 1 Opanayake, 1 Pelwadulla, Ceylon.

Measurements on p. 619.

1267 **Turdoides affinis affinis** (Jerdon) (Travancore) Whiteheaded Babbler 1:193

32: 11 ♂♂ 17 ♀♀ 4 o?

5 N. Kanara; 1 Mundgoda, Dharwar Dist; 1 Hikkerisagar, Mysore; 1 Kallar, Nilgiris; 2 Tope, Palnis; 2 Trivandrum, Kerala, 1 Nagarcoil, Kanyakumari Dist.; 1 Pt. Calimere,[1] Tanjore Dist.; 1 Tithamalai, 6 Kurumbapatti, 2 Chitteri Range, Salem Dist; 1 Vellore, 1 Madras City; 1 Shriharikota, 1 Palkonda Hills, 1 Seshachalam Hills, S. Cuddappah, A.P.; 2 Golapalli, Bastar, M.P.; 2? locality?

The 10 birds with white heads include 5 (1 ♂ 4 ♀) from N. Kanara. The other five (again 1 ♂ 4 ♀) are from Dharwar, Salem (3) and Cuddapah Dist. The N. Kanara series was collected in 1890/1 and the white on the head is slightly foxed, though still forming a very distinct cap. In both males the head cannot be said to be pure white, the colour flowing into that of the back. All this suggests that the white head is restricted to the adult female?

The series from N. Kanara has darker underparts as also the two from Tope, Palni Hills (1958/9). The others also show colour differences which cannot be isolated.

Measurements on p. 619.

1268 **Turdoides affinis taprobanus** Ripley, (Ceylon), Ceylon Whiteheaded Babbler.

1 ♂ Uragala, Ceylon

The bird does not have a white head and there are no markings on the chin or upper breast.

Measurements on p. 619.

1269 **Turdoides nipalensis** (Hodgson) (Nepal) Spiny Babbler 1:204

3: 2 ♂♂ 1 ♀

1 Baila 3500′, Doti, West Nepal; 1 6500′ Nepal Valley; 1 5500′ N. Katmandu Valley.

The female (R. L. Fleming, Baila, Doti) and male (D. Proud, N. Katmandu Valley) are marked as having the "iris pale blue" while the other male (Nepal Valley, D. Proud) is said to have been "white". Hodgson, quoted in Stuart Baker's FAUNA said it was smoky brown while the HANDBOOK (6:236) says white.

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[1] "Specimen No. 23880, 22 December 1973, from Point Calimere was labelled *T. striatus* by the collector. Field observers have always considered the *Turdoides* species found in coastal forest at Calimere to be *striatus* but this specimen appears to me to be *affinis*. A.J. Gaston (pers. comm.) informs me that the vocalisations of the birds found at Calimere are more like those of *affinis* than *striatus*."

Measurements on p. 619.

1270 **Babax lanceolatus woodi** Finn (Kanpetlet, Mt. Victoria, Chin Hills) Chinese Babax 1:187

2: 1 ♂ 1 ♀ Mount Victoria, Chin Hills, Burma.

Measurements on p. 619.

1271 **Babax waddelli waddelli** Dresser (Tsangpo Valley, Tibet = Chaksam) Giant Babax 1:189

1 o? Rongka, Tibet.

Measurements on p. 619.

(See Measurements on pp. 615-619)

	Wing	Bill	Tarsus	Tail
	1235 Panurus biarmicus russicus			
o? (2)	62, 62	9.2, 10.5	20.6, —	75, 86
	(IH ♂♂ 58-65	from skull c. 10	21	83-99
	♀♀ 53-62	„ c. 10	21	83-92)
	1236 Conostoma aemodium			
♂ (1)	126	24	38.5	128
	(IH ♂♂ 120-132	from skull 24	39-40	129-140)
	1237 Paradoxornis unicolor			
♂ (1)	95	16.5	29.5	112
♀ (1)	88	15.7	28.3	107
	(IH ♂♂ 85-92	from skull 16	31	99-107
	♀♀ 88	—	—	—)
	1238 Paradoxornis fulvifrons fulvifrons			
♂ (1)	55	9.5	19	53
♀ (1)	54	8.6	18.7	45
	(IH ♂♂ 56-57	from skull 7	—	—
	♀♀ 55-56	„ 7	18	60)
	1241/42 Paradoxornis nipalensis humii/poliotis			
1241 *humii* o? (1)	54	9.5	18.7	57
	(IH ♂♀ 45-51	from skull 7-8	c. 19	52-57)
1242 *poliotis* ♂♂ (3)	48, 49, 49*	9, 9, 9*	16.5*, 19, 19.5	50, 53*, 46
„ ♀ (1)	51	8.3	18.2	53
	Tezu sp. marked*			
	(IH ♂♀ 44-46	from skull c. 7	18	52
	1246 Paradoxornis atrosuperciliaris atrosuperciliaris			
♂♂ (3)	71-74 av. 72.3	11.7-12.2 av. 11.9	22.5-25 av. 23.4	73-79 av. 76.7
	(IH ♂ 74	—	—	—
	♀ 70	from skull 11	22	71)

1247/8 **Paradoxornis ruficeps** subspp.

	WING	BILL	TARSUS	TAIL
ruficeps ♂ (1)	88	16	27	74
" ♀♀ (4)	82-88 av. 84.5	15-16 av. 15.4	25.5-28.7 av. 27.2	66-76 av. 72
	(IH ♂♀ 84-90	from skull 15-16	28-29	75-85)
bakeri ♂ (1)	88	16.2	24.6	72
" ♀ (1)	83	16.7	25.2	71
" o? (1)	81	16	25	73
	(IH ♂♀ 89-95	from skull 15	28	82-85)

1249/50 **Paradoxornis gularis** subspp.

	WING	BILL	TARSUS	TAIL
1249 *gularis* ♂ (1)	89	15.5	23.7	77
" ♀ (1)	85	14	23.4	77
	(IH ♂♂ 85-95	from skull 13-14	27	74-80
	♀♀ 84-89	12(1)	23(1)	74(1)
1250 *transfluvialis* ♀ (1)	90	15.5	21.6	73
	(IH ♂♀ 86-90	from skull 12-13	25	78)

1251 **Paradoxornis flavirostris flavirostris**

	WING	BILL	TARSUS	TAIL
♀ (1)	81	18.2	25.6	90
	(IH ♂♀ 85-90	c. 12 (from feathers)	c. 30	100-110)

1252 **Paradoxornis guttaticollis**

	WING	BILL	TARSUS	TAIL
♂ (1)	86	18.4	28.5	97
o? (3)	84-85 av. 84.4	17.5-19.5 av. 18.7	25.4-25.7 av. 25.5	93-98 av. 95.3
	(IH 80-85	8-9	**26**	100)

1253 et seq **Turdoides caudatus** subspp.

	WING	BILL	TARSUS	TAIL
♂♂				
huttoni (4)	84-91	20.5-22.6	26.5-30 av. 28.9	104-129 av. 119
caudatus (27)	76-83 av. **79**	17-20.6 av. 18.7	22.5-28.5 av. 25.9	95-122 av. 108
eclipes (5)	82-87 av. **84.6**	18.2-20.4 av. 19.6	25.2-27.2 av. 26.4	118-130 av. 120
salvadori (4)	85-91 av. **86.8**	20-22.2 av. 20.8	27.1-28.5 av. 27.7	107-123 av. 117
theresae (7)	84-91 av. **88.1**	19.8-23.7 av. 22.5	27.7-32.1 av. 29.7	112-123 av. 116.6
♀♀				
huttoni (3)	81, 85, 87	21, 21.6, 21.8	26.6, 27.5, 28.5	102, 106, 107
caudatus (10)	74-81 av. 76.8	18.4-19.5 av. 19	24-29.5 av. 26.3	87-110 av. 102.5
eclipes (5)	78-84 av. 80	19-20.6 av. 20.1	21.2-26.5 av. 24.4	109-123 av. 114.5
salvadori (2)	85, 88	18.9, 20.6	27.1, 28.2	116, 124
theresae (3)	85, 87, 88	19.2, 20.3, 21.7	27.5, 27.7, 30.4	117, 118, 120

Turdoides squamiceps

	Wing	Bill	Tarsus	Tail
muscatensis o? (3)	111, 111, 106	21.5, 21.9, 21.5	28.6, 30, 31.2	133, 128, 115
yemenesis ♀ (1)	109	23	28.5	132
	1255/56 Turdoides earlei subspp.			
1255 *sonivius* ♂♂ (6)	86-95 av. 90.6	20.8-22.3 av. 21.5	28-32 av. 29.8	100-123 av. 109.6
„ ♀♀ (2)	92, 95	20.7, 21.5	30.6, 31.5	119, 125
„ o? (1)	82	17.7	29.7	65
1256 *earlei* ♂♂ (6)	88-92 av. 90.1	19-22.3 av. 20.9	29-32.5 av. 30.2	98*-115 av. 109.9 *worn
„ ♀♀ (3)	87, 89, 95	19.3, 21, 22	30(3)	103, 108, 113
„ o? (1)	90	20.8	30.5	102
	Turdoides altirostris			
♂♂ (2)	80, 81	19.4, 21.3	26, 28	105, 105
♀♀ (3)	70, 74, 72	17, 19.2, 17.5	25.5, 24.5, 28.2	98, 96 broken
o? (2)	78, 73	18.8, 17.3	26.6, 21.5	103, 88
	1257 Turdoides longirostris			
1 ♂ 1 o?	78, 74 (IH ♂♀ 75-79	21.3, 19 *c.* 18-19	30, 29 *c.* 30	110, 93 115-120)
	1258 Turdoides malcolmi			
♂♂ (7)	112-121 av. 117 (IH 108-120	18.7-21 av. 20.1 from skull 22-27	29.5-33 av. 31.2 35-36	125-135 av. 130.8 129-145)
♀♀ (14)	103-122 av. 114 (IH 110-118	17.3-20.2 av. 19 from skull 23-24	28.6-38.8 av. 31.4 34-35	100-142 av. 126 128-136)
o? (3)	96, 107, 117	15.6, 18.6, 19	26, 30.5, 32	85, 120, 135
	1259/60 Turdoides subrufus subspp.			
1259 *subrufus* ♂♂ (11)	87-92 av. 91 (IH ♂♂ 89-94	17.5-19.9 av. 18.9 from skull 21-25	29.5-34 av. 31.2 33	98-117 av. 110.4 115-118)
subrufus ♀ (1)	90 (IH ♀♀ 88-92	18.6 21-22	32.5 33	105 103-105)
subrufus o? (2)	90, 91	20, 20	30.5, 33.6	107, 110
1260 *hyperythrus* ♀♀ (2,1 juv*)	86*, 90	15*, 18.5	30.6, 31*	78*, 103

1261-1265 **Turdoides striatus** subspp.

	Wing	Bill	Tarsus	Tail
1261 *sindianus* ♂♂ (7, 1 juv.)	94-116 (Simla) av. 105	20.5-21,5 av. 21.1	30.5-34.6 av. 32.5	98-116 av. 107.3
	(IH 104-111	from skull 21-25	35-37	100-114)
„ ♀♀ (12, 3 juv.)	99-115 av. 104.4	19.2-21.5 av. 20.7	30.2-36.2 av. 32.8	103-117 av. 106
	(IH 99-110	from skull 23-25	35	104-110)
„ o? (4, 1 albino*)	104*-112 av. 107.2	20-22.8 av. 20.9	30.3-31 av. 30.5	105-114 av. 109
1262(a) *orientalis* ♂♂ (9)	97-105 av. 100.5	18.5-22.6 av. 20.1	30.4-32.7 av. 31.7	88-107 av. 97.7
„ ♀♀ (3)	96, 104, 104, av. 101.3	19.1, 19.9, 21 av. 20	31.3, 33.1, 34.6 av. 33	87, 101, 103 av. 97
	(IH ♂♀ 94-111	from skull 21-25	33-36	93-117)
1262(b) „ ♂♂ (6)	102-107 av. 104.1	20.3-23.2 av. 21.9	31.7-35.5 av. 33.4	95-11 av. 106
„ ♀♀ (10)	97-110 av. 101.9	18.1-23.7 av. 20.9	31-35 av. 32.8	99-112 av. 104.4
	(IH included with	1262 (a) above)		
1262(c) „ ♂♂ (4)	97-103 av. 101	17-22 av. 20.3	29.6-32.7 av. 31.4	96-101 av. 98.1
„ ♀♀ (2)	93, 101	18.5, 19	31, 31.8	91, 96
1263 *somervillei*				
(a) *Khandala & Ghats*				
♂♂ (3)	104-108 av. 106	20-21.5 av. 20.6	31.7-33 av. 32.2	98-106 av. 101.3
♀♀ (3)	105-108 av. 106	16.5*-21.4 av. 21.2 *bill deformed	32.5-33.7 av. 32.9	99-104 av. 101
o? (1)	104	21.2	33.2	100
(b) *Surat, Bombay, Ratnagiri* (below ghats)				
♂♂ (16, 2 juv.)	98-107 av. 102.7	18.9-23.4 av. 21.5	27-34.5 av. 32.2	88-107 av. 99.3
♀♀ (7)	99-107 av. 103.8	19.6-23.4 av. 21.7	31.5-33.7 av. 32.7	97-108 av. 102.5
o? (1)	100	20.5	30.6	100
(c) *Goa & N. Kanara*				
♂♂ (8)	97-108 av. 103.3	18.6-21 av. 19.9	31.2-34 av. 32.4	96-103 av. 98.2
♀ (1)	105	21.6	33.4	101
	(IH ♂♀ 98-109 (av. of 11-102.5)	from skull 22-26	35-37	98-111)
1264 *malabaricus* ♂♂ (6)	99-107 av. 101.8	19.4-21.1 av. 20.2	30.5-34.5 av. 32.4	95-111 av. 101.1
	(IH 101-107	from skull 24-25	*c.* 36	105)
♀♀ (7)	101-107 av. 104.1	19.5-20.5 av. 20.1	31.4-34.5 av. 32.8	96-107 av. 99.2
	(IH 101-109	from skull 22-24	33-35	99-102)

	WING	BILL	TARSUS	TAIL
1264a, 1265 Turdoides striatus subspp.				
1264(a) *orissae* ♂♂ (2)	102, 104	21.4, 22	32.7, 33.3	103, 107
	(IH 103, 104	from skull 25	35	102, 107)
„ ♀♀ (4)	93, 110 av. 99	20.4-21.4 av. 21	30.8-34.4 av. 32.2	94-107 av. 99.5
	(IH 94, 99	25, 23	35	96, 102)
1265 *striatus* ♂♂ (2)	100, 108	22.3, 23.3	33.6, 36	103, 110
	(IH 103-111	from skull c. 24	32-34	95-111)
„ ♀♀ (6)	101-108 av. 104.3	19.3-21.7 av. 20.3	30-36 av. 33.5	99-108 av. 102.6
	(IH 96-107	from skull 23-24	*c.* 33	102-104)
1266 Turdoides rufescens				
♂ (1)	107	19.5	33	106
	(IH ♂ 104-113	from skull 22-24	33-34	112-119)
♀♀ (2)	100, 102	20.3-20.8	32, 36.2	107, 111
	(IH ♀ 97-106	22-24	32-35	107-121)
1267/68 Turdoides affinis subspp.				
1267 *affinis* ♂♂ (11)	95-109 av. 103.2	18-20.9 av. 19.03	29-34.7 av. 32.2	92-105 av. 98.2
	(IH ♂♂ 94-109	from skull 20-22	32-35	95-107)
„ ♀♀ (17)	101-108 av. 103.4	16-20.5 av. 18.5	28-33.7 av. 31	92-111 av. 99.2
	(IH ♀♀ 99-110	from skull 19-23	31-35	95-109)
1267 *affinis* o? (4)	101, 104, 105, 106	17.9, 18.1, 18.5, 19.3	29, 30.5, 30.7, 31	92, 98, 99, 99
1268 *taprobanus* ♂	102	18.6	32.7	97
	(IH ♂♂ 102-110	from skull 21-22	31-32	101-102)
1269 Turdoides nipalensis				
♂♂ (2)	87, 89	23, 33.3	28, 29.3	113, 115
	(IH ♂♂ 79-86	from skull 21-25	30-32	104-117)
♀ (1)	84	—	28.2	104
	(IH ♀ 81-87	20-26	30-33	107-117)
1270 Babax lanceolatus woodi				
♂ (1)	99	—	35.6	121
♀ (1)	106	25.7	34	116
	(IH ♂♀ *c.* 100	*c.* 25	*c.* 35	*c.* 140)
1271 Babax waddelli waddelli				
o?	130	30.7	35.5	152
	(IH ♂♀ 130-138 av. 134	from skull 34-40 av. 36	—	150-155 ex Vaurie)

(*to be continued*)

GEOGRAPHIC VARIATION IN THE BARASINGHA OR SWAMP DEER (*CERVUS DUVAUCELI*)[1]

Colin P. Groves[2]

(*With five plates & four-text-figures*)

The Barasingha or Swamp Deer, *C. devauceli,* is revised; a new subspecies is described from Assam. Adaptations and relationships of the species are briefly reviewed.

The Barasingha or Swamp Deer (*Cervus duvauceli*) was reputedly spread widely in Northern India and southern Nepal in historic times. Lydekker (1907) gives the distribution from the Assam valley in the east to the Kyarda Dun in the west, and from the foot of the Himalaya south to the Godavari river; with a few outliers in the Sunderbans to the east and on the Indus to the west. North of the Ganges it would be restricted to swampy grasslands; south of it, to Sal forest. Today the species is reduced to three small pockets: the Nepal-India border in the Kumaun-Kanchanpur-Dudhwa-Kheri region; a few sanctuaries in Assam (Manas, Orang and Kaziranga); and the Kanha National Park, near Mandla, Madhya Pradesh. The only recent record outside these three areas is for the Chitawan district of Nepal; Schaller (1967) quotes R. Willan to the effect that "a few" occur there, but they are extinct there today (A. Laurie, *pers. comm.*). It seems probable that the species was always restricted to pockets of suitable country, such that local extermination was relatively easy.

Since the work of Pocock (1943), the species has been divided into two subspecies: *C. d. duvauceli,* the true Swamp Deer from north of the Ganges, and *C. d. branderi,* the Hard-ground Barasingha from between the Ganges and Godavari rivers. Apart from the hooves — splaying, with bare pasterns in the former, and hard-knit with normally haired pasterns in the latter — the differences between the two have always been a little vague, due in part to the changes with sex and season, in part to lack of familiarity with living specimens.

Both the Assam and the Nepal/U.P. populations have customarily been assigned to the nominate subspecies, *C. d. duvauceli*: but M. K. Ranjitsinh (*in epist.*, 1979, 1980) has noted that they differ strongly from one another, and suggested to me that it might be worthwhile to investigate the possibility that they differ subspecifically.

Material and Methods

Skulls and antlers of this species were examined and measured in the following institutions: British Museum (Natural History); Powell-Cotton Museum, Birchington, Kent; Bombay Natural History Society; Van Ingen & Van Ingen, Mysore; Indian Forestry College, Dehra Dun; and the private collections at the palaces of H. H. the Maharana Saheb of Wankaner and H. H. the Maharaja of

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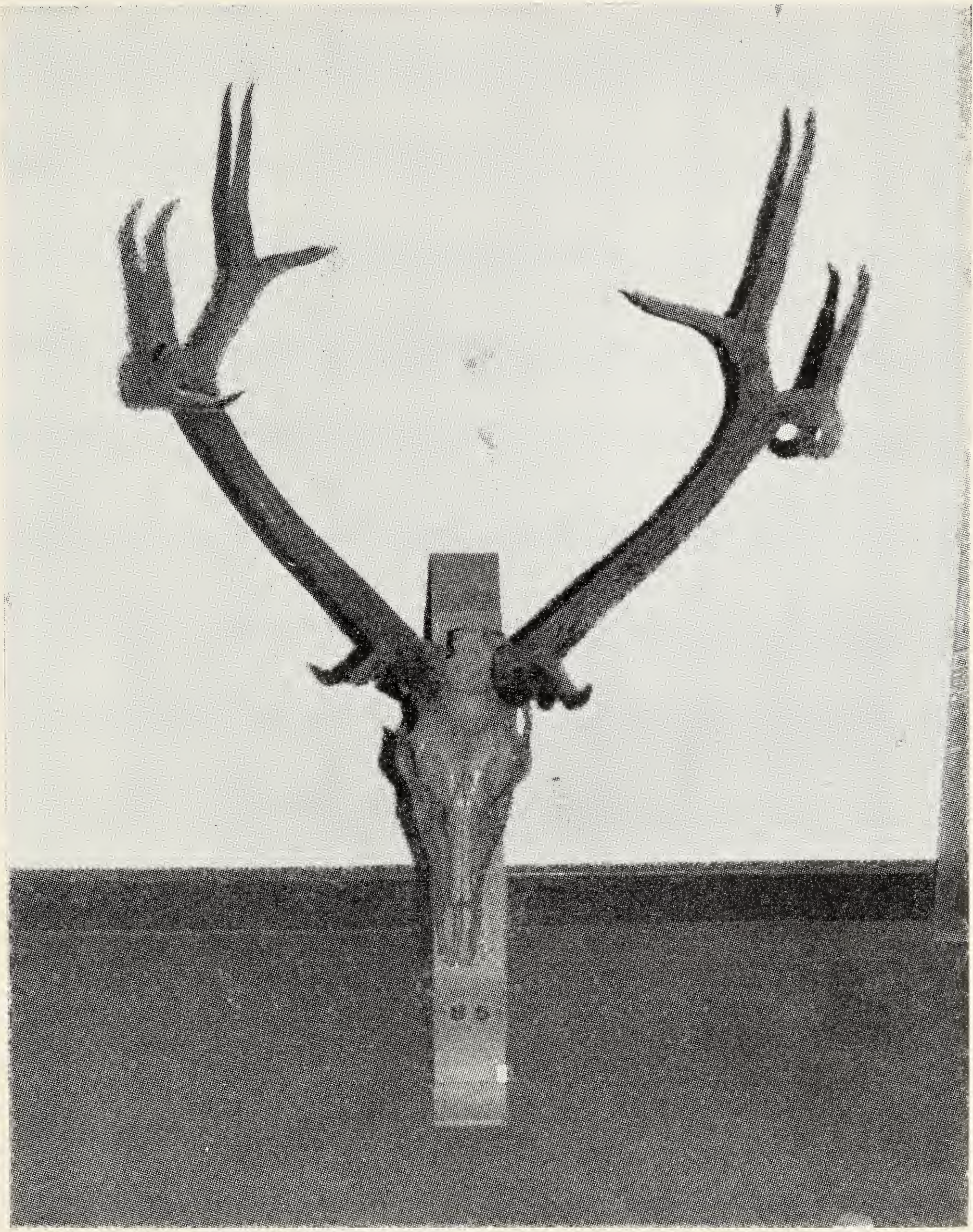
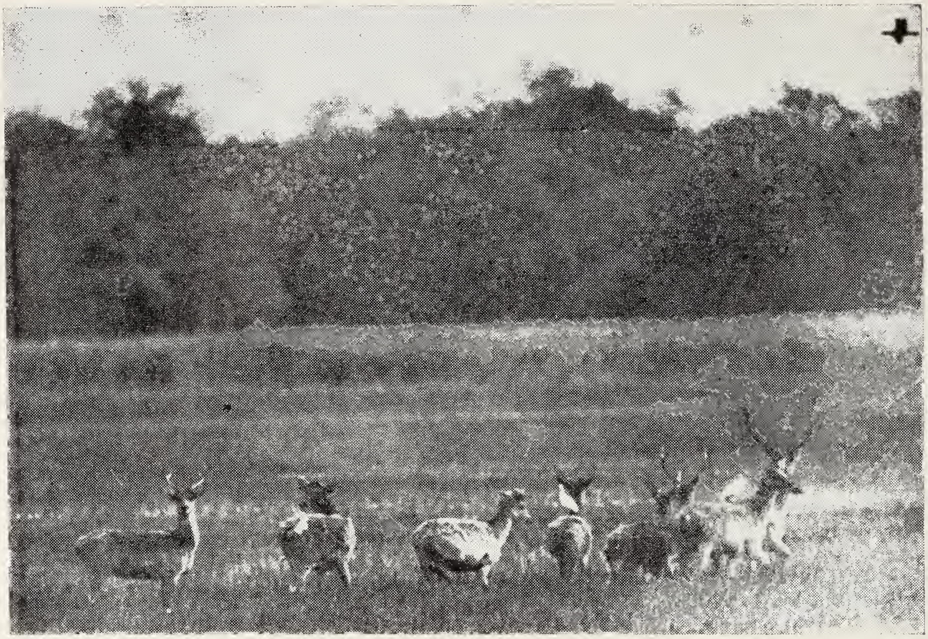
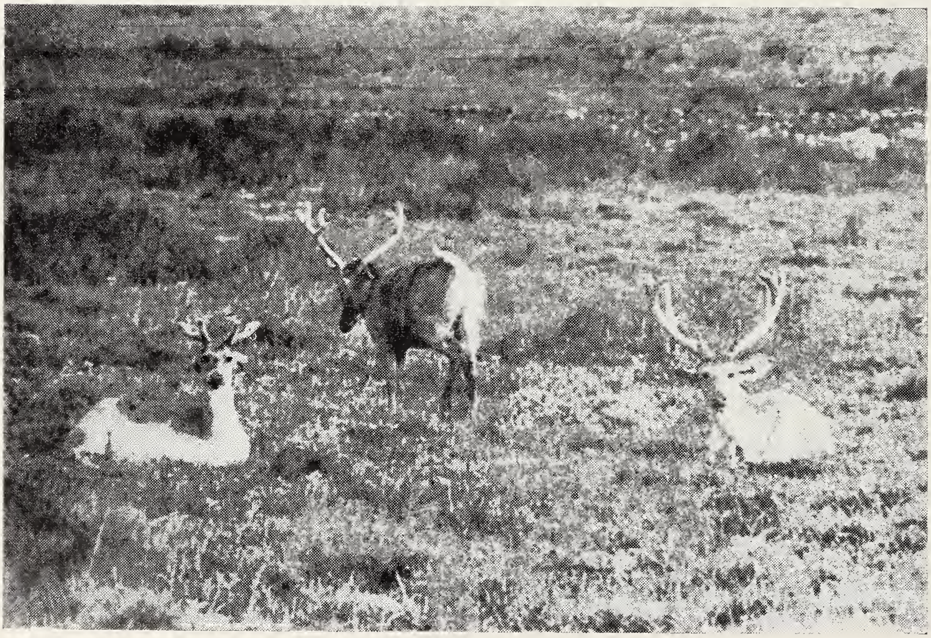


Fig. 5. Skull of *C. d. duvauceli,* BM 12.10.31.6, from Kheri.
(Photo: *M. K. Ranjitsinh*)





Above: Fig. 6. Herd of *C. d. duvauceli*: Kishanpur Sanctuary, Pilibit district, U.P.
Below: Fig. 8. *C. d. ranjitsinhi* in Kaziranga National Park, Assam.
(Photo: *M. K. Ranjitsinh*)

TABLE

MEASUREMENTS OF SKULLS (ALL MALE) AND ANTLERS *Ccrvus duvauceli*

	C. d. duvauceli						*C. d. ranjitsinhi*			*C. d. branderi*		
	Kumaun			Kheri			Assam			M.P.		
	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.	n	Mean	s.d.	n
Greatest skull length	377.0	6.24	3	393.2	7.49	6	388.7	10.26	3	366.7	6.11	3
Nasal length	129.7	9.07	3	130.5	8.55	6	138.3	9.29	3	127.5	—	2
Nose depth	52.3	4.16	3	53.8	4.92	5	57.7	2.08	3	50.0	—	2
Snout length	132.3	2.89	3	132.6	5.94	5	125.0	—	2	114.5	—	2
Antler length	686.4	13.43	5	675.1	39.79	8	626.0	58.62	3	706.8	39.39	5
Burr to brow tine	47.6	9.61	5	57.5	8.00	8	58.3	15.00	3	58.8	12.89	5
Brow tine to main fork	381.0	57.69	5	361.5	47.47	8	332.3	28.36	3	402.4	49.53	5
Length of brow tine	239.8	26.98	5	306.9	37.96	8	233.0	89.11	3	299.8	35.51	5
Length of anterior branch	306.0	42.95	5	309.9	46.65	8	263.3	43.66	3	345.6	39.48	5
Length of posterior branch	278.8	53.66	5	276.9	42.23	8	241.3	69.00	3	264.2	35.79	5

Kolhapur. With one exception, all skulls in the collection are male.

The skull measurements taken were mostly those of Lowe & Gardiner (1974). Standardisation of skull measurements within restricted groups of vertebrates is very desirable, and I would like to take this opportunity to recommend that future workers on the Cervidae follow the Lowe & Gardiner method, which seems to describe all major parameters of skull variation. A few measurements were also taken on antlers and their pedicels: both antero-posterior and transverse diameters of pedicels and of the antlers themselves between burr and brow-tine; and lengths of tines and distances between branching-points. It should be noted that the point of measurement on the antler was always the centre of the node, i.e. the triradius where the longitudinal grain of the tine meets the ascending and descending grains of the beam.

RESULTS

The skulls and antlers studied were assignable to four main geographic samples: Kumaun, Kheri (Sarda river, Pilibit, Sonaripore, Bahraich), Assam (including Gauhati), and Madhya Pradesh. Under this latter heading are included specimens from the Mandla district, where the species still survives; from Junga (approx. 20°N., 82°20′E.); and from "Dewas", (probably the Dewas district some 400 km west of Mandla). Two skulls from Nanpara and two from "Nepal" were studied in addition.

Samples differed from one another in absolute skull size, as measured by greatest length; nasal length (Lowe & Gardiner, 1974: 200, Appendix I, measurement no. 7); nose depth (Lowe & Gardiner no. 15); snout length (Lowe & Gardiner no. 5); minimum maxilla breadth (Lowe & Gardiner no. 9); antler length; length of brow-tine; and distances between branching points of antlers. These measurements are listed, with means and standard deviations for each of the four samples, in the Table; and depicted in bivariate plots in Figs. 1-4.

The Kumaun and Kheri samples differ in two features only: absolute size, and length

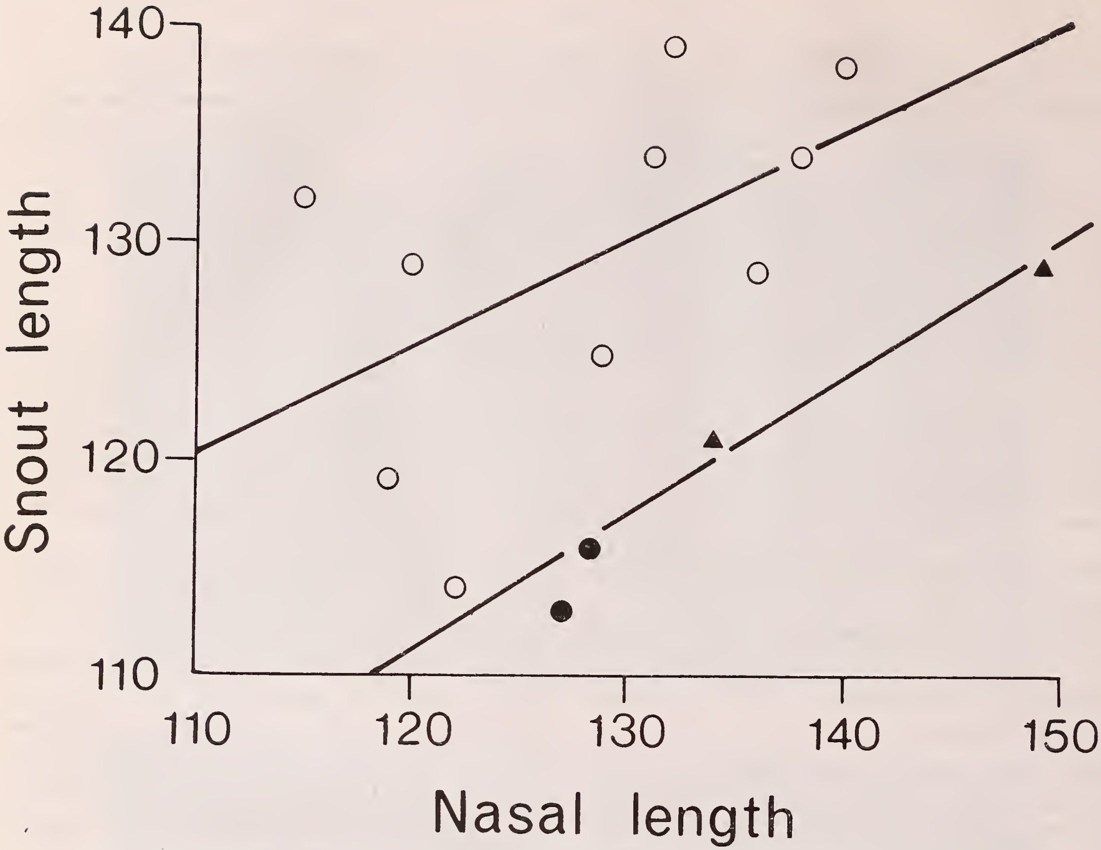


Fig. 1. Plot of Nasal Length *vs.* Snout Length (Lowe & Gardiner, 1974, nos. 7 *vs.* 5). Regression equations as follows:

C. d. duvauceli:	$y = 63.77 + 0.511\ x\ (r = .555)$
C. d. ranjitsinhi + branderi:	$y = 29.00 + 0.675\ x\ (r = .979)$

of brow-tine. Although the size difference is quite marked, known environmental responses in the growth of deer (Huxley, 1931; Hoogerwerf, 1956) suggest extreme caution before assuming a genetic basis for this. Brow tine length, though again quite strongly different on average in the two, overlaps when observed ranges are considered, and the standard deviation limits nearly overlap.

The two Nanpara skulls are 373 and 385 mm long respectively; they are thus within the Kumaun size range, although separated from the Kumaun area by the Kheri region. This clearly identifies the size difference as of strictly limited significance: a microgeographic phenomenon, whether genetic or environmental. Brow-tine lengths are 305 mm in both, nearly identical to the Kheri mean, indicating in this case a rather clearer geographic trend. An adult skull from "Nepal" in the British Museum is 397 mm long with a brow-tine of 340, both characters aligning it with Kheri;

but the exact locality in Nepal is unknown. The second Nepal specimen, the type of *Cervus dimorphe* Hodgson, is a young adult of 364 mm, with deformed antlers: it was reared in captivity for at least a year (Hodgson 1843), and is doubtless stunted.

Assam skulls are between the two above samples in size, but with long nasals, deep muzzle, short snout, short antlers branching low down, and short brow-tine. While none of these differences by itself quite reaches the conventional level of subspecific differentiation (75% rule), the bivariate plots throw the shape differences into relief. The nasals are very long

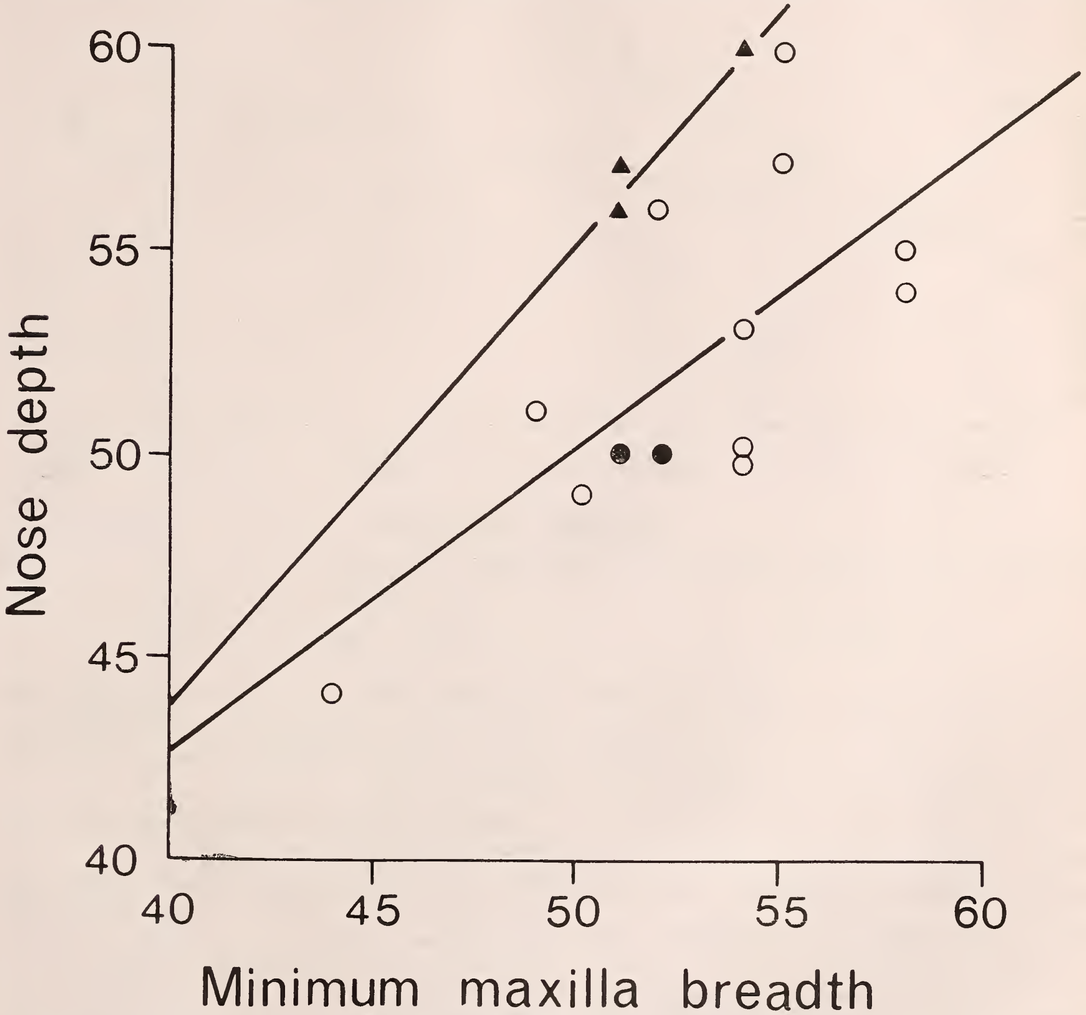


Fig. 2. Plot of Nose Depth *vs.* Minimum maxilla breadth (Lowe & Gardiner, 1974, nos. 15 *vs.* 9). Regression equations as follows:

C. d. duvauceli:	$y = 11.94 + 0.767\ x\ (r = .710)$
C. d. ranjitsinhi:	$y = -3.00 + 1.167\ x\ (r = .971)$

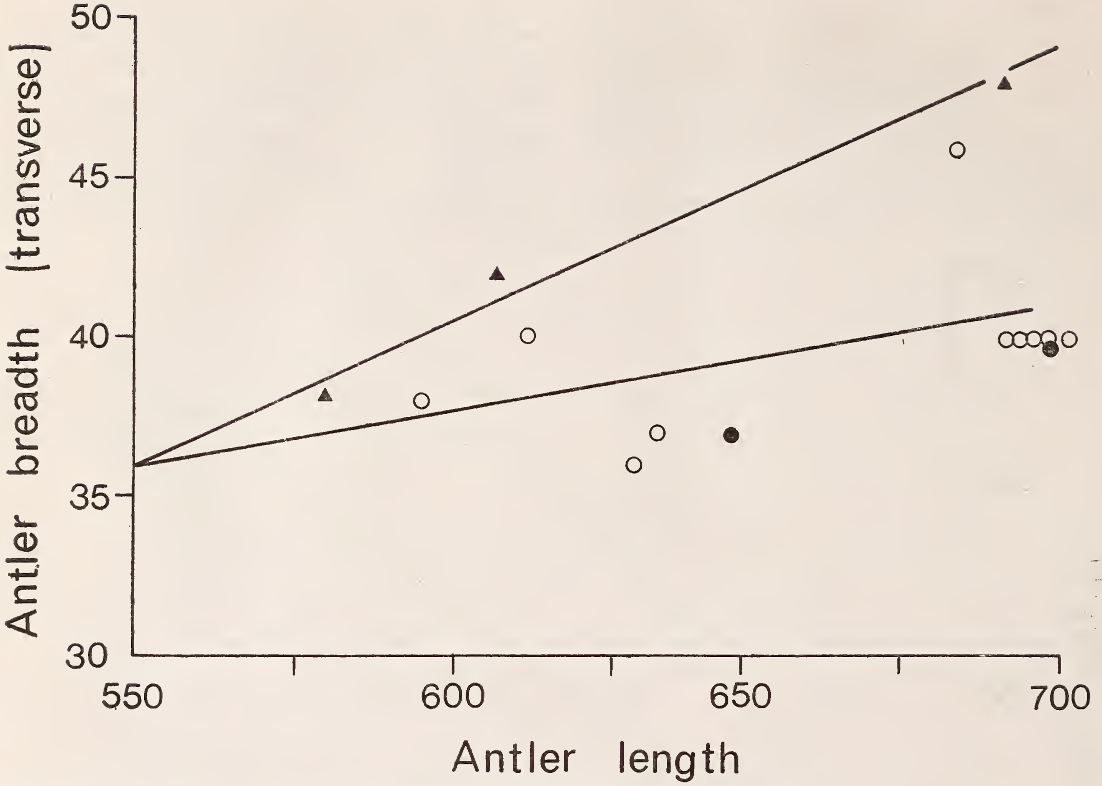


Fig. 3. Plot of Antler Breadth (transverse) *vs.* Antler Length. Regression:

C. d. duvauceli:	$y = 18.54 + 0.032\,x$ (r = .496)
C. d. ranjitsinhi:	$y = -10.17 + 0.084\,x$ (r = .983)

relative to the snout length (Fig. 1); the nose is deep but narrow (Fig. 2); the antlers are short and thick (Fig. 3) and their pedicels tend to be antero-posteriorly flattened (Fig. 4), though this is not such a strong difference.

Madhya Pradesh skulls, referable to *C. d. branderi,* are small in size with a very short snout; the antlers are very long, with a long beam before the first fork, and the anterior branch is especially long. In the shape relationships in which the Assam sample differ from Kheri and Kumaun, the M.P. sample fall with the latter: except in the long nasals and short snout in which they are like Assam. It is evident that on the basis of its skull and antler form, *C. d. branderi* is a valid subspecies; while a further subspecies needs to be recognised for Assam.

Cervus duvauceli duvauceli G. Cuvier, 1823. Western Swamp Deer; Gond.

1823	*Cervus duvaucelii* G. Cuvier. "No doubt North India" (Pocock, 1943); Kumaun here chosen.
1835	*Cervus elaphoides* Hodgson. Nepal.
1837	*Cervus smithii* Grey. Northern India; Kumaun here chosen.
1843	*Cervus dimorphe* Hodgson. Morung region, Nepal.
1850	*Cervus euceros* Gray. "India": Kumaun here chosen.

1868 *Cervus eucladoceros* Falconer. South of Hardwar.

Specimens seen. Kumaun 5 [BM(NH) 3, IFC 2], Nanpara 2 (Van Ingen), Pilibit 2 (Wankaner), Kheri 8 [BM(NH)], Nepal 2 [BM(NH)].

Diagnosis: Nasals short relative to snout length, nose not deep, antlers long, slender, not compressed or palmated (Fig. 5).

Description. Observations of living herds show that the hinds are very large in this form,

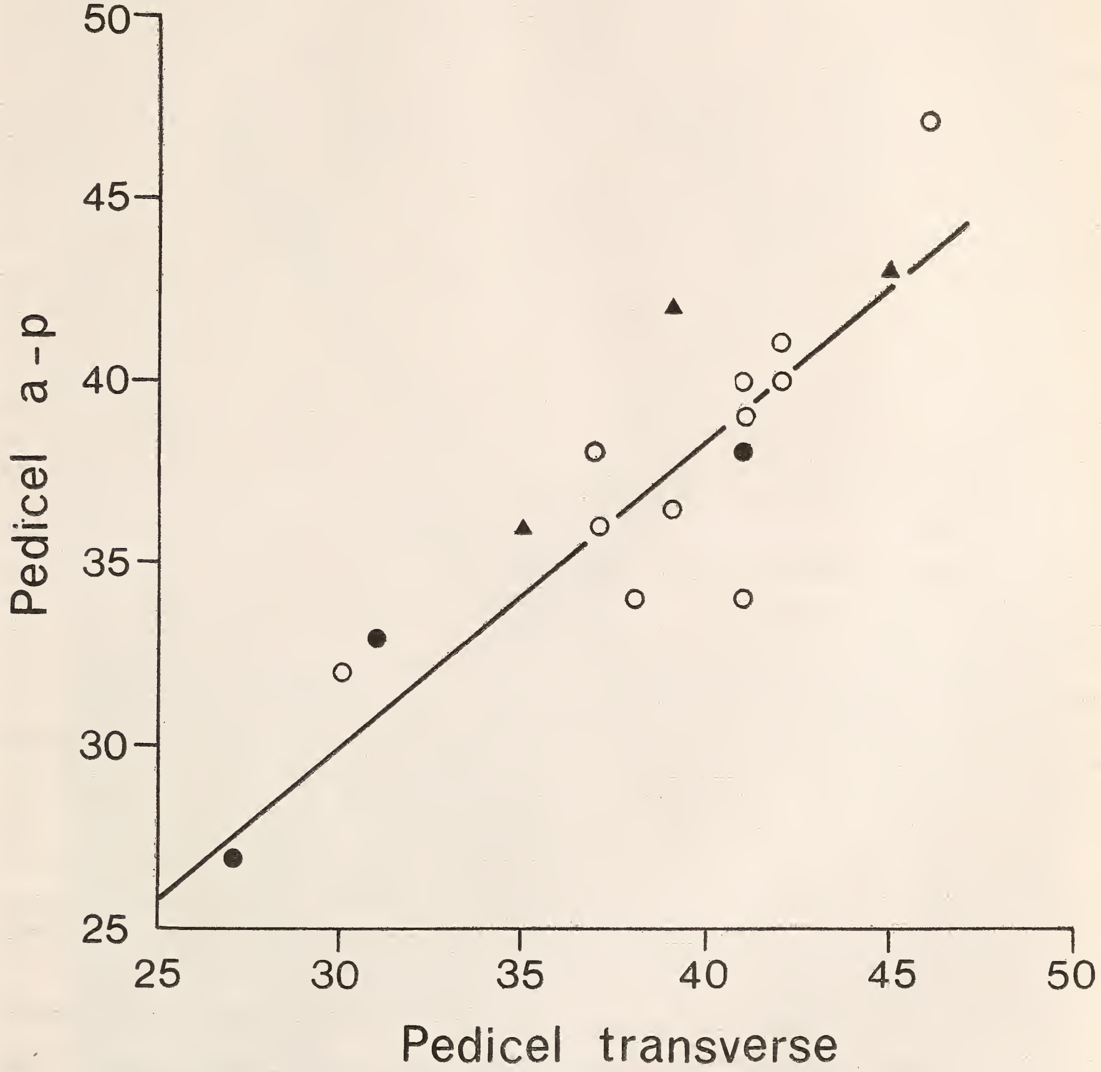


Fig. 4. Plot of Pedicel diameters: transverse *vs.* antero-posterior. Regressions of:

C. d. duvauceli: $5 = 5.24 + 0.829\ x\ (r = .83)$
C. d. ranjitsinhi: $y = 14.24 + 0.678\ x\ (r = .875)$
C. d. branderi: $y = 8.55 + 0.731\ x\ (r = .957)$

comparable in size with the stags, and with a thicker neck; the tail in both sexes is relatively long and slim with prominent white hair on the undersurface; the ears are very large and rounded, with a thick growth of white hair on the inside. Fig. 6 shows some of these features; good close-up photos can be found in Schaaf (1979). The Kheri sample is, as mentioned above, slightly differentiated from the Kumaun one: by its large size (perhaps not a genetic character) and elongated brow-tine. The Nanpara specimens are smaller again, but have the same long brow-tine; they possibly represent the same population as the now extinct Chitawan barasingha.

None of the names in the above synonymy is very firmly based; and only *Cervus dimorphe* appears to be represented by a type specimen, which is a young adult skull with antlers deformed by captivity. On historical grounds there is no probability that any of the names apply to the Assam valley race, which thus needs a new name.

Cervus duvauceli ranjitsinhi subsp. nov.
Eastern Swamp Deer or Barasingha

Type. British Museum (Natural History) 91.2.7.9, skull with antlers, from Gauhati, Assam, presented by A. O. Hume in 1891. The skull is mounted on a display shield, and the basicranium has been cut off to mount it.

Referred specimens. (1) BM(NH) 23.10.5.54, "Assam", skull with antlers, the anterior maxillae and premaxillae missing. (2) BM(NH) 12.10.31.5, Gauhati.

Origin of name. For M. K. Ranjitsinh, presently Secretary of the Forest Department, State of Madhya Pradesh, India. Ranjitsinh's name has been associated with many wildlife conservation projects in India, and recently in Thailand; in the late 1960s his insistence and energy was primarily responsible for reviving *C. d. branderi* from near extinction, and he has more recently been concerned in the still more difficult problem of saving the Manipur Thamin (*C. eldi eldi*).

Diagnosis. Compared with the nominate race, distinguished by its elongated nasals and short deep snout; short thick antlers, branching low down, with especially shortened anterior branch; antlers somewhat compressed and tend to be palmated (Fig. 7).

Description. M. K. Ranjitsinh (*in press; in litt.*, 4.8.1980 and 2.9.1980) points out that in the field this race is heavily built, but linearly of the same height as *C. d. branderi*, i.e. smaller than the nominate race and with the hinds especially small; the muzzle is more slender from side to side and pointed, giving the impression of being more elongated; the ears, which have very little white hair on the insides unlike the other two races, are smaller, less rounded and distinctly pointed; the tail is shorter; and in moult the white spots in the mid-dorsal region are much less prominent. These features are clearly visible in Figs. 8 and 9, as are the short, flattened, low-branching, somewhat palmated antlers, highly characteristic in the field. The feet are splayed with bare "heels", as in the nominate race, as far as is known.

Notes. Although for comparative purposes the small number of specimens is to be regretted, collection of further specimens is clearly undesirable at this time. From a conservation point of view the identification of this new subspecies is of the greatest urgency.

Cervus duvauceli branderi Pocock. Southern Swamp Deer; Hard-ground Barasingha

1943 *Rucervus duvauceli branderi* Pocock. Mandla.

Specimens seen. "Central Provinces" 2 [BM(NH)], Mandla 3 [holotype, BM(NH); Wankaner, 2], Junga 1 (Powell-Cotton Museum), Dewas 2 (Kolhapur).

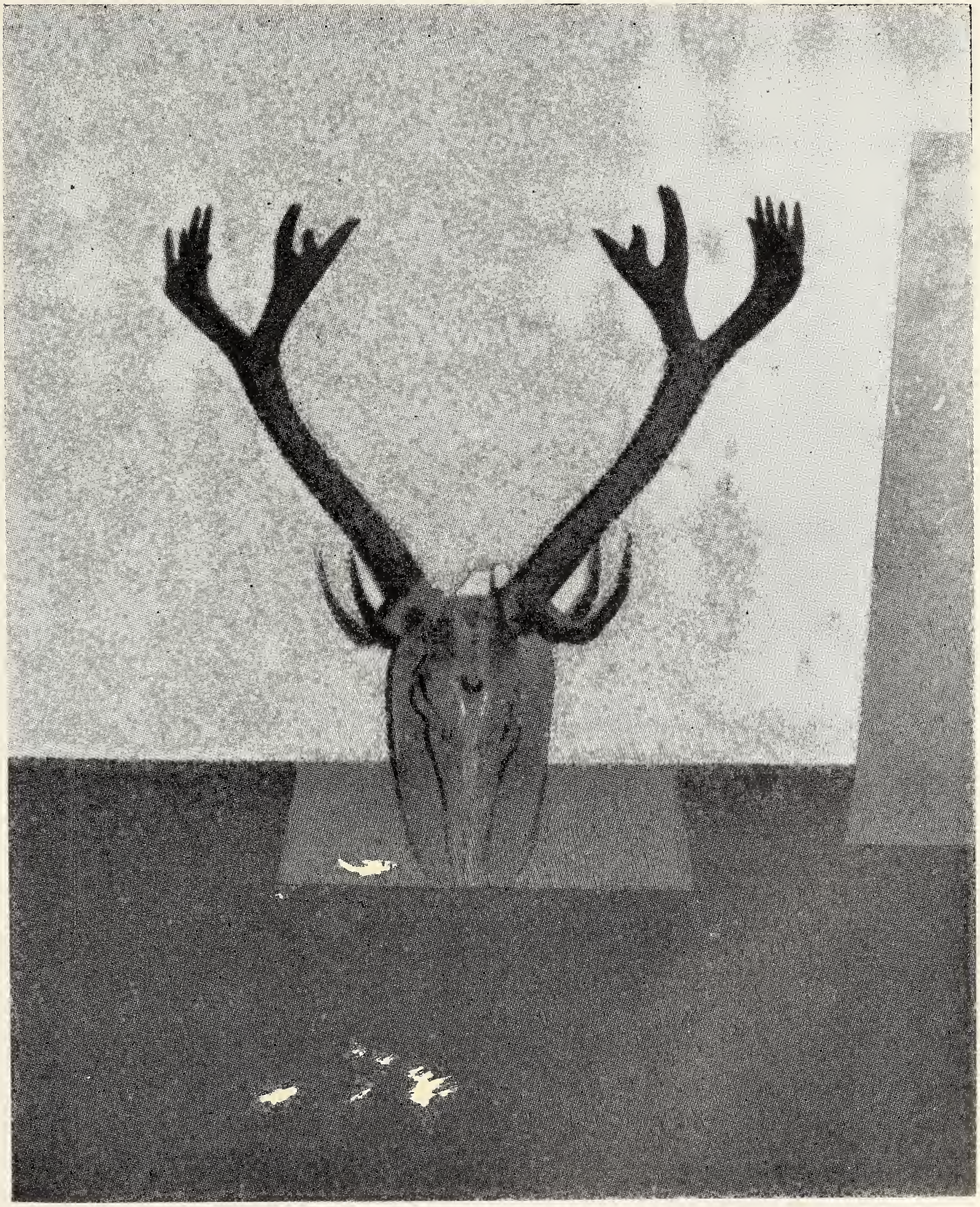
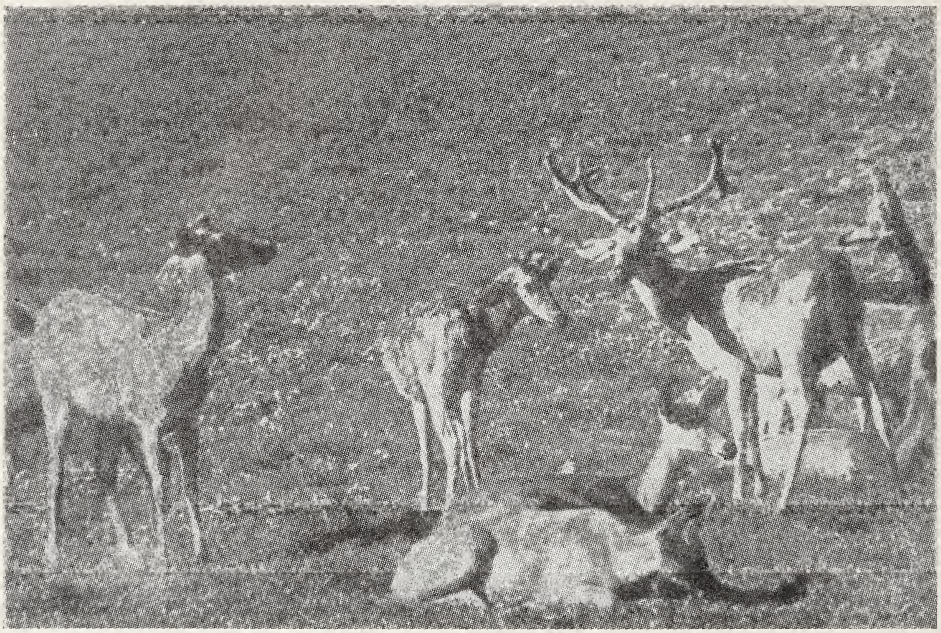
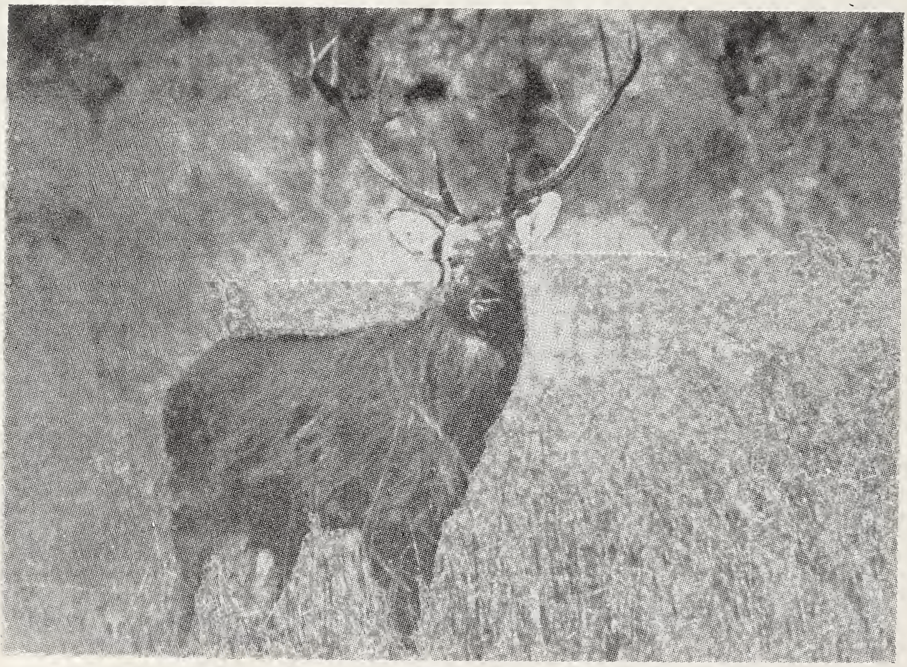


Fig. 7. Skull of *C. d. ranjitsinhi*, BM 91.8.7.9, from Gauhati (Holotype).
(Photo: *M. K. Ranjitsinh*)





Above: Fig. 9. *C. d. ranjitsinhi* in Kaziranga National Park, Assam.
Below: Fig. 11. *C. d. branderi* stag: Kanha National Park, M.P.
(Photos: *M. K. Ranjitsinh*)

Diagnosis. The feet are "well-knit", with hair-covered pasterns, unlike the other two races; size is small; nasals long, snout short as in *ranjitsinhi*, but nose is not deep; maxilla rather broad as in nominate race; antlers as in nominate race but extremely long and many-branched, with long brow-tine; branching high up the beam, and anterior branch especially long (Fig. 10).

Description. According to M. K. Ranjitsinh (*in litt.*), the stag has a darker rutting pelage than either of the other two races, a better developed ruff on the neck, and a noticeably short snout. The note by Dunbar Brander (1923) that the colour is "often" much darker is plainly a failure to distinguish between rutting and non-rutting pelage. A supposed colour difference in the antlers, also mentioned by Dunbar Brander, is difficult to maintain on modern observations, and was in any case disputed by Pocock (1943).

As in the nominate race the ears are large and rounded, with thick white hair internally; the tail is somewhat shorter, but not as short as in *C. d. ranjitsinhi;* the muzzle is broad and blunt; there are prominent white spots along the dorsal lines, especially during the moult (Fig. 11). Lydekker (1907) records an unusual "curved" type of antler from the (then) Central Provinces (now Madhya Pradesh), on the evidence of a series shot by Major C. B. Wood; but for Dunbar Brander this is the "Terai" type, being rarer according to him in the Central Provinces, whereas the straight, spreading type is rare elsewhere. This discrepancy is probably a matter of semantics: most antlers, throughout the range, would appear to be of the type Dunbar Brander calls "intermediate" (and which indeed accounts for 14 out of his sample of 31 heads), but the finest, most spreading and angular antlers are almost confined to M.P. It is interesting that Dunbar Barnder classes 3 out of his 31 as of "sambar type"; and Ranjitsinh (*in litt.*) has occasionally seen individuals in Kanha with antlers "quite indistinguishable" from sambar.

DISCUSSION

The discovery of a new subspecies of *Cervus duvauceli* raises the question of the nature of the species and its adaptation; what are its nearest relatives, and what was its original habitat: swampy grassland, or Sal forest and glades?

Although *C. duvauceli* and its relatives, *C. schomburgki* and *C. eldi,* have traditionally been referred to a subgenus *Rucervus,* there have been dissenting voices. Pocock (1943) referred each to a separate genus — *Rucervus, Thaocervus* and *Panolia* respectively — implying that interrelationships among them are no closer than between any one of them and the other subgenera of *Cervus* (or rather, in Pocock's scheme, genera of the Cervinae): such as *Cervus, Rusa, Ussa* and *Axis.* Such a classification appears much oversplit: it neither indicates any closer degrees of relationship, nor does it use the species category in any useful way, since most of the genera are monospecific.

A very different, and surely more useful classification, is that of Flerov (1952). This author arranges the species of *Cervus* in just five subgenera: *Cervus* (for *C. elaphus* and *C. nippon*), *Axis* (for *C. axis, C. porcinus, C. calamianensis* and *C. kuhli*), *Dama* (for *C. dama* and *C. mesopotamica*), *Przewalskium* (for *C. albirostris*) and *Rusa* (for *C. alfredi, C. timoriensis, C. tavistocki, C. unicolor, C. duvauceli, C. schomburgki* and *C. eldi*). The characters on which this arrangement are based are well defined, and the fivefold division seems acceptable, at least as a working arrangement.

For present purposes, the point that "*Rucervus*" and *Rusa sensu stricto* are closely related is accepted.

Many species of Flerov's subgenus *Rusa* are, broadly, adapted to soft ground, and often to parkland as much as forest (there is a clear differentiation here between *C. unicolor* and *C. timoriensis*). As well as two of the three races of *C. duvauceli*, one of *C. eldi* has invaded swampland. It seems plausible that adaptation to a swampy environment may have occurred independently in different species, and equally that such adaptations may have been reversed.

For a number of reasons it seems more likely that *C. duvauceli* is basically adapted to swamplands, and that it is *C. d. branderi* which has invaded a new habitat. First is the fact that *C. d. duvauceli* does not utilise the Sal forest and interspersed meadows in its range, habitat that is the very type to which *C. d. branderi* is confined; on the other hand, there is no suitable swampy grassland habitat within the range of the latter. Thus the nominate race, as far as habitat goes, has a (hypothetical) choice, and "chooses" swampland; while *branderi* is constrained.

The second line of evidence comes from Indian prehistory. The rich profusion of rock paintings at Bhimbetka, near Hoshangabad, M.P., shows a faunal variety which includes rhinoceros (presumably *Rhinoceros unicornis*) and wild buffalo (*Bubalus arnee*), as well as Swamp Deer, recognisable at once by their complex antlers (Mathpal 1978). Buffalo and rhino are the two Indo-Nepalese species which are consistently associated with swampy plains, and their presence in the Bhimbetka paintings implies that [at an uncertain date, perhaps early Holocene (Mathpal 1978)] in the past there was such habitat in Madhya Pradesh, not too far from Kanha and the Mandla district. The depictions of Barasingha suggests that this species was able to extend its range to the region when conditions were right, and that when the environment changed the Barasingha, unlike the rhino and buffalo, was able to adapt and survive in unfamiliar habitat, in isolation (by the Ganges valley) from its parent populations further north.

The final point to be made concerns a Thailand relative, the now extinct Schomburgk's deer (*Cervus schomburgki*). Pocock (1943) separated this species from *Rucervus* as genus *Thaocervus;* the differences invoked were marginal at best, and depended on a single skull of the new genus. The habitat, in the Central Plains of Thailand, was precisely that of the two northern races of *C. duvauceli* (Lekagul & McNeely 1977), and indeed Giles (1937) argues strongly that it is only a local form of *C. duvauceli*. This latter view is probably correct: the differences from the Barasingha are probably no greater than those among the three Indian subspecies. Its dark colour and neck mane were like *branderi;* the form of the ears and tail resembles both *branderi* and *duvauceli;* but the form of the antlers, while quite idiosyncratic, in their low branching and flattened form were most like *ranjitsinhi*. It is interesting that, despite the habitat, the pasterns were hairy (Mohr 1968, Abb. 11); which might mark this as the most primitive of the subspecies of swamp deer. Whether the swamp-living "pre-*branderi*" had bare pasterns and has lost them, or never had them, would in this light be an open question.

CONCLUSION

I conclude that *Cervus duvauceli* is a deer basically adapted to swampy grassland conditions; that it has three Indian subspecies; that a now extinct deer from Thailand was likewise

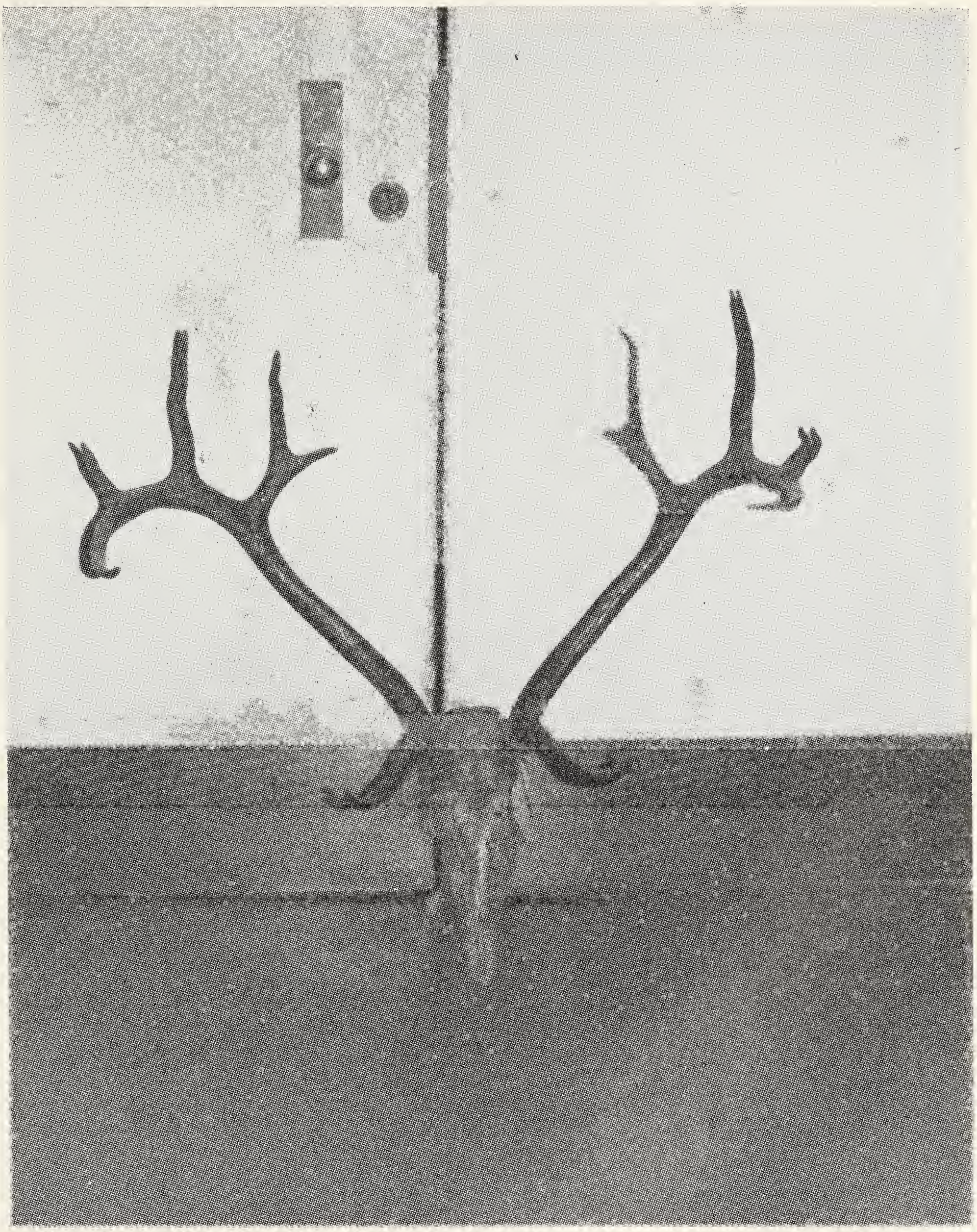


Fig. 10. Skull of *C. d. branderi*: BM 30.4.24.7, from Mandla (Holotype).
(Photo: *M. K. Ranjitsinh*)

probably conspecific; and that environmental change in Madhya Pradesh, south of the Ganges valley, forced the species there to change in response to an altered environment. The two swampland races, of Assam and of U.P./Nepal, have probably, by the very nature of their habitat, been isolated by environmental factors for some thousands of years, rather than being separated by recent extermination of intervening populations as has usually been assumed .

The taxonomic data on the species are as follows:

Genus **Cervus** Linnaeus, 1758.
  Subgenus **Rusa** H. Smith, 1827 (synonyms including *Rucervus* Hodgson, 1841; *Thaocervus* Pocock, 1943)
    Cervus duvauceli G. Cuvier, 1823.
      C. d. duvauceli G. Cuvier, 1823. Kumaun, Kheri, S. W. Nepal.
      C. d. ranjitsinhi subsp. nov. Assam.
      C. d. branderi Pocock, 1943. Mandla district, and formerly west to Dewas, east to Junga.
      C. d. schomburgki Blyth, 1863. Chao Phraya valley, Thailand (extinct since 1938).

Other species of the subgenus are *C. eldi* McClelland, 1842; *C. unicolor* Kerr, 1792; *C. alfredi* Sclater, 1870; *C. mariannus* Desmarest, 1822; and *C. timoriensis* de Blainville, 1822 (of which *C. tavistocki* Lydekker, 1900, is a synonym). For a review of some of these species, especially those in the Philippines, see Grubb & Groves (*in press*).

ACKNOWLEDGEMENTS

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NEW DESCRIPTIONS

A NEW SPECIES OF *OLIGODON* FROM THE PALNI HILLS, SOUTH INDIA (SERPENTES: COLUBRIDAE)[1]

Romulus Whitaker and Shekar Dattatri[2]

(*With a plate*)

INTRODUCTION

While on a herpetological survey of the Palni Hills, South India, we collected a hitherto unreported species of kukri snake of *Oligodon* along with several other interesting reptiles and amphibians. It is named here as:

Oligodon nikhili sp. nov.

Description:

Seven supralabials, the third and the fourth touching the eye; the sixth rising slightly above the labial border; one anterior temporal; internasals present, loreal absent; nostril in elongated nasal completely divided by a vertical suture. Scales around mid body in fifteen rows. Ventrals: 144; Caudals: 33, paired; anal divided.

Hemipenis extending to the 13th caudal plate; proximal quarter of the organ smooth, the next quarter with equal sized spines and the distal half flounced, the flounces edged with numerous small spines; three prominent longitudinal folds present.

Colour:

Ground colour light brown, each scale with a minute black speck. Two chocolate brown dorso-lateral stripes 1.5 scales wide extending from the posterior end of the characteristic chevron head pattern to the tip of the tail. Two indistinct lateral lines on scale row three, extending from above the fifth ventral to the anal plate; belly whitish with prominent ventero-lateral speckling and two broken lines of black spots.

Holotype:

Museum of the Madras Snake Park Trust, an adult male from Tiger shola, 1500 mts., Palni Hills, Tamilnadu, South India, 20.9.81, collected by Romulus and Zahida Whitaker and Shekar Dattatri. No other specimens reported.

Measurements:

Snout-vent:	350 mm
Vent-tail:	73 mm
Total length:	423 mm
Head length:	11 mm
Head width:	9 mm
Neck width:	8 mm
Diameter of eye:	2 mm

Scalation:

Ventrals:	144
Caudals:	33
Scale rows:	17-15-15

DIAGNOSIS AND DISCUSSION

The cylindrical body with smooth scales, presence of the nostril in an elongated nasal, one pre- and two post-oculars, circular pupil of eye, typical head shape and pattern esta-

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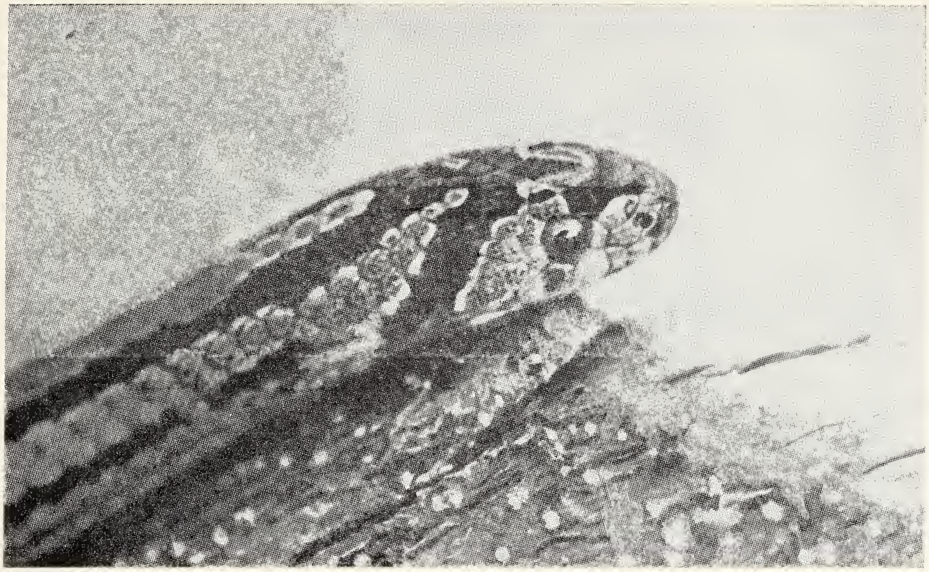
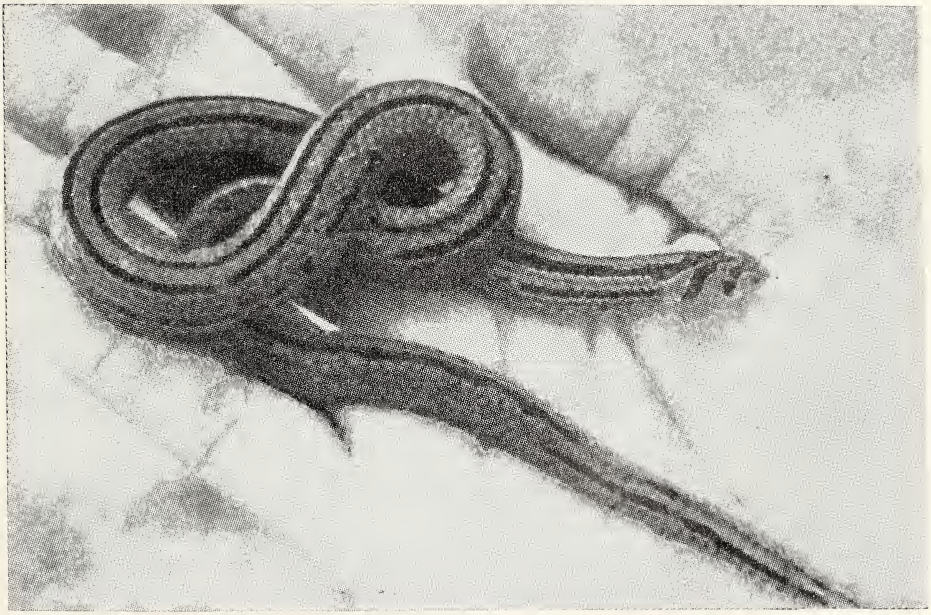
[1] Accepted September 1982.

[2] Madras Snake Park Trust, Madras 600 022.





Oligodon nikhili sp. nov. from Palni Hills, Tamil Nadu.
(Photos: *Rom Whitaker*)

blish beyond doubt that this snake belongs to the Genus *Oligodon*.

Of the 33 species of this Genus recorded from the oriental region, eleven other species have 15 scale rows at mid-body. Tabulated below are the differences exhibited by the holotype compared to the most similar forms.

Character	*O. taeniolatus*	*brevicaudata*	*erythrorachis*	*sublineatus*	new species
1. Supra labials:	7	7	7	7	7
2. Scale rows:	15	15	15	15	15
3. Ventrals:	158-218	158-173	154	134-161	144
4. Caudals:	29-56	25-29	46	23-37	33
5. Loreals:	present	absent	absent	present	absent
6. Inter nasals:	present	absent	present	present	present
7. Distribution	India Sri Lanka	Western Ghats	Assam	Sri Lanka	Western Ghats

From the characters enumerated above, it is evident that the new species closely resembles *O. erythrorachis* described by Wall (1910) based on a single specimen collected in Assam. However, it differs from the latter in coloration and in the ventral and subcaudal counts.

The next most closely resembling species is *O. sublineatus* described from Sri Lanka. However, *O. sublineatus* differs in having complete head shields and in the hemipenis being spinose throughout, the spines being almost uniform in size and regularly arranged. This is not the case with the new species.

Habitat:

Tiger shola, where our specimen was collected, is a medium altitude rain forest (1500 mts. above MSL) a few kilometres below Shembaganur on the Kodaikanal ghat road. It remains one of the few intact pockets of 'shola' forest in the area and on the same trip we collected five species uropeltids (*Uropeltis, Platyplectrurus* and *Teretrurus* spp.), one species of *Xylophis*, several forest frogs and lizards. The new kukri snake was found by the three year old son of one of us (R.W.), Nikhil, who was left at the roadside to play at "snake hunting". The snake was hiding behind a piece of cement on the roadside retaining wall and fell at the child's feet when he removed the loose slab of cement.

CONCLUSION

When we started out on this trip, a new species of snake was the last thing we expected. Our discovery shows only too clearly that a great deal lies hidden in the complex and unique forest hill ranges of the Western ghats. It is appalling to see the destruction man has wrought in many of these areas. Hill slopes that were lush with vegetation in the senior author's younger days are deforested, barren, hot and eroded today. What we are losing in terms of our fauna and flora is anybody's guess.

ACKNOWLEDGEMENT

We are grateful to the Madras Snake Park Trust for funding the survey.

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ON A NEW GENUS AND A NEW SPECIES OF EREMNINAE (CURCULIONIDAE: COLEOPTERA)[1]

H. R. Pajni and C. S. Sidhu[2]

(*With two text-figures*)

INTRODUCTION

We have studied 102 species of subfamily Eremninae during a five year US PL-480 project on Curculionidae of India. The studied species include several new genera and many new species. The present report concerns the description of a new species, *sensarmai* under the new genus *Indophytoscaphus.*

Observations and Discussion

C. chandigarhensis was tentatively referred to genus *Corigetus* (Pajni & Singal 1974), fully realising the remarks of Marshall (1918) about the heterogeneous nature of the genus *Corigetus* Desbr. It was felt that the species might ultimately provide the type for a new genus. An examination of the true *Corigetus* Desbr. in the British Museum (natural history), London has revealed that the rostrum of the present species lacks the characteristic oblique curved costa running from the upper edge of the scrobe towards the middle of the eye and also shows other differences in the structure of the rostrum. Accordingly, this species has been designated as the type of a new genus *Indophytoscaphus* and a new species is also being described under the genus.

The two species of this genus, according to the key to the genera of Cyphicerini by Marshall (1944), resemble the African genus *Afrophytoscaphus* raised by Hustache (1936), but differ from it in several respects. In this genus the antennae are squamose and have the second joint of funicle equal to the first, scrobes do not reach the eyes and the lateral margins of elytra are strongly excised near the bases to receive the dilated bases of metepisterna. In the genus *Afrophytoscaphus* Hust., on the contrary, the antennae are not squamose and have the second joint of funicle shorter than first, the scrobes reach the eyes and the lateral margins of elytra are not excised near bases. The genus is very similar to *Phytoscaphus* in outer appearance but like *Afrophytoscaphus* it also differs from *Phytoscaphus* in having 4 setae on the mentum.

Indophytoscaphus gen. nov.

Head with frons somewhat broader than dorsal area of rostrum; eyes flat, subovate, large. Rostrum distinctly longer than broad, interantennal area bifoveate; epistome very small, forming an obtuse angle behind, with two lateral processes in male; lateral areas each with a squamose costa running straight from scrobe to eye; scrobes small, narrow, curving inwards; mentum with 4 setae. Antennae densely squamose and setose; funicle with first and second joints subequal; club oval. Prothorax rounded laterally, anterior margin with well-developed ocular lobes, subtruncate at base. Elytra with dorsal outline convex, intervals with scale-like setae. Legs with tibiae less slender, corbels of hind tibiae open. Male genitalia with aedeagus pointed

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[1] Accepted July 1981.

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and triangular at apex, without exophallic valve; phallotreme with small orificial plates. Female genitalia with bursa copulatrix moderately developed; spermatheca with collum and ramus lying parallel to each other.

KEY TO THE SPECIES OF GENUS *Indophytoscaphus* GEN. NOV.

1. Prothorax transverse; rostrum stouter and broader; scutellum squarish .... *chandigarhensis* Pajni and Singal

Prothorax as long as broad; rostrum slender and narrower; scutellum rectangular, longer than broad .... *sensarmai* sp. nov.

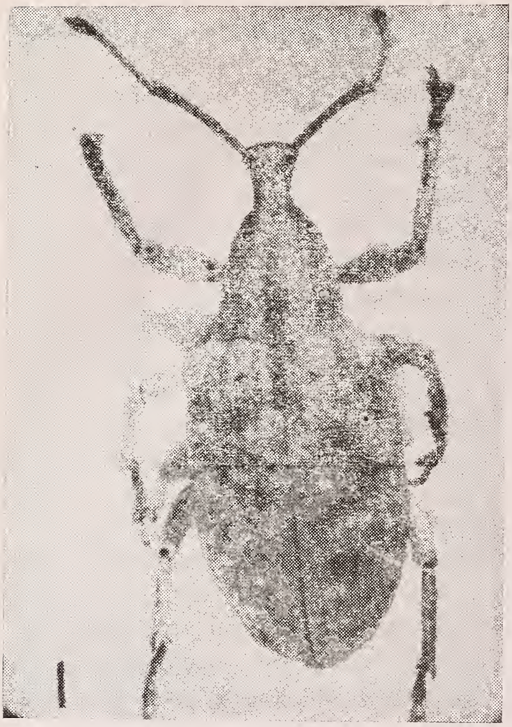
Indophytoscaphus sensarmai sp. nov.

Figs. (1 & 2)

Head with frons black, somewhat broader than dorsal area of rostrum, flat in front and a little convex behind, separated from rostrum by a shallow transverse impression, densely covered with pale scales and sub-erect broad setae; central fovea deep and elongated, almost concealed by scales; eyes shining black, large, sub-ovate, flat. Rostrum black, distinctly longer than its apical width, running parallel from base to scrobes, then strongly dilated at apex; dorsal area deeply impressed throughout, densely covered with pale scales and broad pale setae, with interantennal area bifoveate; central carina fine, running throughout its length, concealed by scales; dorsolateral carinae distinct, diverging apically and parallel behind; epistome very small, forming an obtuse angle behind; lateral areas each with a squamose costa running from scrobe straight to eye and a deep longitudinal stria running above and below it; scrobes small, narrow, curving inwards, almost visible from above. Antennae moderately long, fuscous, densely clothed with whitish scales and pale recumbent setae; scape cylindrical, gradually clavate, almost straight, reaching one-third of prothorax; funicle with joints 1 and 2 subequal, 3-6 subequal but half as long as 2, 7 a little longer, each joint with a distinct whorl of sub-recumbent whitish setae; club fuscous, small, sub-globular, with apex acuminate, as long as 2 apical funicular segments, finely and uniformly pubescent.

Prothorax black, almost as long as broad, with anterior margin straight, having well-developed ocular lobes and fine vibrissae; dorsal surface convex, coarsely and somewhat closely punctate and each puncture with a very short and pale recumbent seta, covered with interspersed pale and brownish scales; lateral sides narrowly rounded, almost as broad at apex as at slightly bisinuate base. Scutellum small, rectangular with its anterior margin rounded, completely covered with whitish-pale scales. Elytra black, oblong, dorsal outline convex, running parallel from base to beyond middle and then narrowing at apex, with apices jointly sinuate, much wider at shoulders than base of prothorax, shoulders very prominent and roundly rectangular; striae narrower than intervals, formed by deep squarish punctures and each puncture with a minute seta, interspaces squamose; intervals broad, flat, densely covered with dark-brown and brownish scales and some patches of whitish scales, each interval with a row of distantly placed scale-like recumbent setae.

Legs black, densely covered with pale scales and fine recumbent setae; fore-coxae contiguous, placed in middle of prosternum; femora clavate, each with a small femoral tooth; anterior tibiae bisinuate internally, with a row of spines on their inner apical halves, apical end of each tibia with a fringe of fuscous bristles and a mucro, corbels of hind tibiae open; tarsi densely setose, first joint of hind tarsi 1.5 times as long as second, third bilobed joint shorter than second and spongy beneath; claws free. Thoracic sterna black, densely



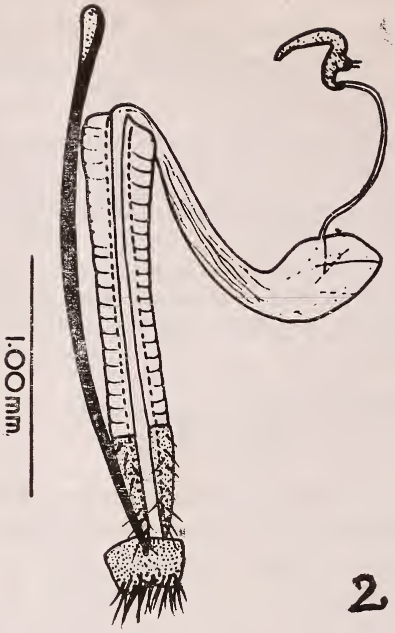


Fig. 1. Adult *Indophytoscaphus sensarmai* sp. nov.
Fig. 2. Female genitalia of *Indophytoscaphus sensarmai* sp. nov.

covered with pale scales, punctate and each puncture with a short and spathulate pale seta. Abdominal sterna black, covered with brownish and greenish scales, punctate and each puncture with a recumbent pale-seta.

Male genitalia not studied. Female genitalia with ovipositor long and weakly sclerotized; coxites comparatively more sclerotized and sparsely setose; bursa copulatrix moderately developed, with a pair of plates at apex; spiculum ventrale long, thick and bent, spathulate at apex. Spermatheca with cornu pointed, collum and ramus lying parallel to each other.

Measurements:

LENGTH:

Female body: 7.0 to 7.6 mm; rostrum: 1.2 to 1.3 mm.

BREADTH:

Female body 2.7 to 3.1 mm; rostrum: 0.7 to 0.8 mm.

Holotype ♀; Dehradun (U.P.); wild vegetation; H. R. Pajni: Paratypes 2♀; Dehradun (U.P.); 1 ♀, Nadaun (H.P.); source and collector for paratypes same as for Holotype: Material in department of Zoology, Punjab University, Chandigarh.

Remarks: This species is more or less similar to the type species i.e., *I. chandigarhensis* (Pajni and Singal) in general appearance and colour pattern of the scales on the body. However, it differs from the same in the structure of the rostrum, the prothorax, and the scutellum. The rostrum is relatively narrower, prothorax almost as long as broad and the scutellum is longer than broad in this species as compared to the broader rostrum, transverse prothorax and squarish scutellum in *I. chandigarhensis* (Pajni and Singal 1974).

ACKNOWLEDGEMENTS

We are grateful to Indian Council of Agricultural Research and U.S. department of Agriculture for financing a project on Curculionidae of India and for arranging funds for the visit of senior author to various European museums. They are also thankful to Dr. R. T. Thompson of British Museum (natural history), London, for allowing the comparison of material with the identified collection. Research facilities provided by Chairman, Zoology department, Panjab University, Chandigarh are also gratefully acknowledged.

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RECORD OF *POLYPEDILUM* KIEFFER (DIPTERA: CHIRONOMIDAE) IN BHUTAN AND INDIA WITH A NEW SPECIES FROM INDIA[1]

D. K. GUHA[2] AND P. K. CHAUDHURI[3]

(*With seven text-figures*)

The survey of Chironomids from Bhutan and India yielded a large number of insects belonging to the different subfamilies of family Chironomidae. The account of the species in each genera have been published or awaits publication elsewhere (Chaudhuri & Ghosh 1981, 1982). This paper records three species of the genus *Polypedilum* Kieffer, previously known from the countries other than India, and describes one Indian species as new to Science. In Bhutan, the genus is represented by four species namely *Polypedilum ascium, P. chaudhurii, P. nudiceps* and *P. tripunctum* recently described by Chaudhuri *ed al.* (1981).

The insects including types of the species are at present kept in the collections at the department of Zoology, University of Burdwan and will be deposited in the National Zoological Collections, Zoological Survey of India, Calcutta.

KEY TO THE SPECIES OF *Polypedilum* KIEFFER

1. Wing pattern with clouds and pale spots.....2
   Wing pattern without clouds but with dark spots 3
2. Fore tibial scale triangular with a sharp spine; Anal point trifid .... *aegyptium* Kief.
   Fore tibial scale oval without such spine; Anal point simple and slender......*stictopterus* John.

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[1] Accepted March 1982.

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3. Gonostylus bulky bearing 6 setae at its inner apical margin .... *alticola* Kief.
Gonostylus moderate bearing 12 setae at its inner apical margin .... *obscurum* sp. nov.

Polypedilum aegyptium Kieffer

Polypedilum aegyptium Kieffer, 1925, *Bull. Soc. ent. Egypte 8*: 270; Freeman, 1958. *Bull. Br. Mus. nat. Hist. Ent. 6*: 281. *Polypedilum iris* Goetghebuer, 1937, In Linder: *Die. Flieg. Palaear. Reg. 3*(13c): 61. *Polypedilum airense* Freeman, 1956, *Bull. I.F.A.N., 18(A)*: 96.

This species is recognised by the absence of frontal tubercle, presence of dark brown thorax bearing 14-16 paired acrostichals, 8 dorsocentrals, prealars 3 and scutellars; triangular fore tibial scale having a sharp spine; wing with similar nature of brown markings and clouds as shown by Freeman (1958). The hypopygeal features of the present species conform with those described by Freeman (1958) in the African species.

Material examined: 5 ♂♂, Arunachal Pradesh, Pasighat, 2-3, iv. 1977, Coll. B. Bhuyian; 2 ♂♂, Burdwan, West Bengal, 4. iv. 1980, Coll. P. K. Chaudhuri; 1 ♂, Garia, West Bengal, 18.v.1980, Coll. P. K. Chaudhuri.

Polypedilum alticola Kieffer

Polypedilum alticola Kieffer, 1913, *Voy. All aud. Jean. afr. Or. Ins. Dipt., 1*: 22; Freeman, 1955, *Explor. Parc. nat. Albert. Miss. de Witte*, 83: 26; Freeman, 1955. *S. afr. Animal Life, 2*: 377; Freeman, 1958, *Bull. Br. Mus. nat. Hist. Ent., 6*: 272; *Chironomus ornatipus* Kieffer, 1918, *Ann. Mus. nat. Hung., 16*: 68.

The species is distinguished by the wing spots of which the most conspicuous are at the basal third of cell R_{4+5}, other markings being faint. The characters in the present species fully resemble the African counterparts described by Freeman (1958) except the chaetotaxy which have been put forward as: acrostichals 10 in pairs, dorsocentrals 10, prealars 2 and scutellars 8 in thorax.

Material examined: 4 ♂♂, Raniganj, West Bengal, 17.vii.1977, Coll. P. K. Chaudhuri.

Polypedilum stictopterus Johannsen

Microtendipes stictopterus Kieffer, 1921, *Philip. J. Sci., 18*: 580.

Polypedilum stictopterus Johannsen, 1932, *Arch. Hydrobiol. Suppl.* 11: 518.

Identification of this species was made by pale spots on the wing, fore tibial scale and the flagellomeres of antenna. Other characters are more or less similar to those described by Johannsen (1932). The chaetotaxy of thorax which may be added to the original description are: acrostichals 12 in pairs, dorsocentrals 9, prealars 3 and scutellars 10.

Material examined: 3 ♀♀, Darjeeling, India, 23.iii.1969, Coll. P. K. Chaudhuri.

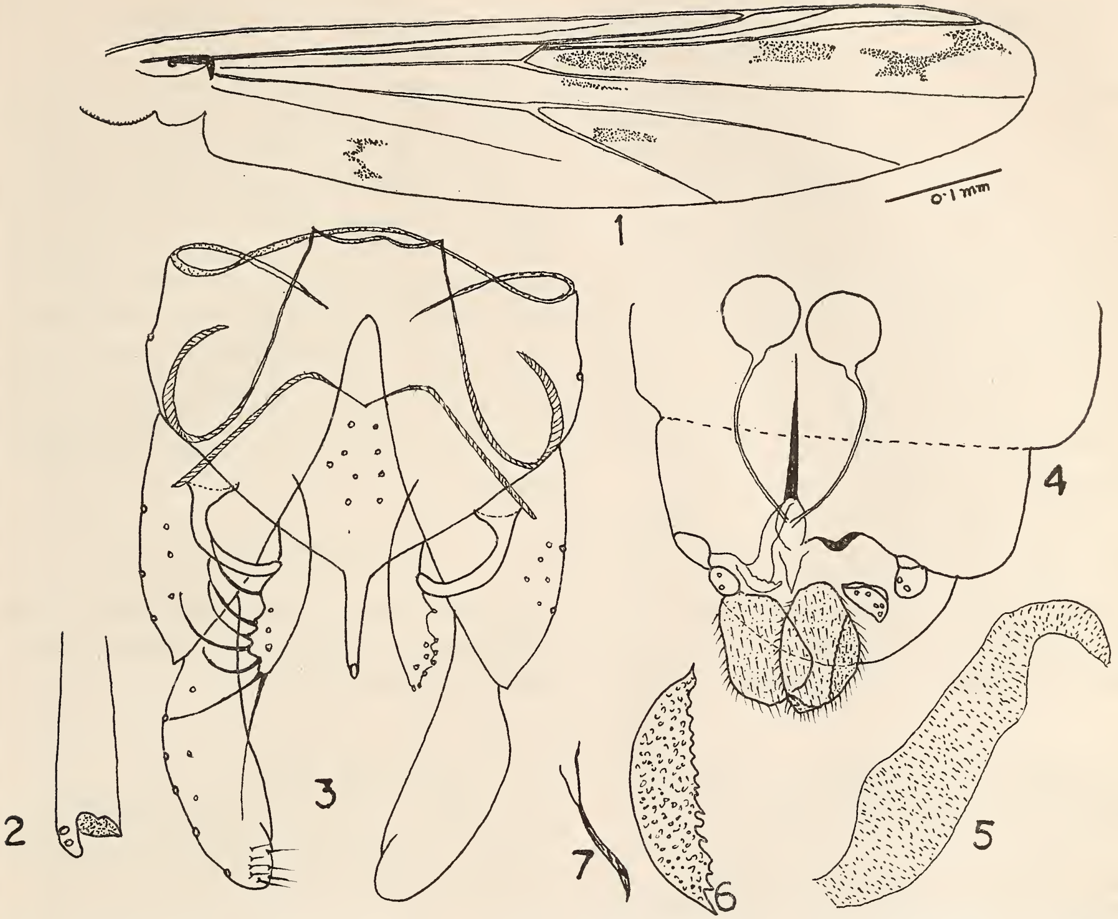
Polypedilum obscurum sp. nov.

MALE: Body length 4.41 mm, wing length 1.94 mm and breadth 0.52 mm.

Head: Dark brown in colour. Vertex with 13 setae. Corona with 4 setae. Clypeus with 24 setae, clypeal ratio 0.87. Eyes bare, reinform with a dorsal extension of 0.12 mm long. Frontal tubercle absent. Antenna dark brown, length ratio of flagellomeres I - XIV 3:2:2:2:2:2:2:2:2:2:2:1 : 1 : 1:45, AR 1.96. Pedicel ratio 1.0, CA 0.53, CP 1.23.

Thorax: Dark brown in colour. Antepronotum thin collar like without emergination. Acrostichals 18-20 in pairs, dorsocentrals 24-26 at the anterior half, prealars 4. Scutellum with 12-13 setae, postscutellum dark brown and bare.

Wing (Fig. 1): Hyaline with yellow veins.



Figs. 1-7. ***Polypedilum obscurum*** sp. nov. 1. Wing; 2. Fore tibial scale; 3. Male hypopygium; 4. Female genitalia 5. Dorsomesal lobe 6. Ventrolateral lobe; 7. Apodeme lobe.

Brachiolum with 1 seta. R with 18, R_1 11 and R_{4+5} with 20 setae; R_{2+3} meets C at distance of 0.17 away from R_1; r-m proximal to f-cu; An ends below f-cu. Wing with spots distributed as: cell R_{4+5} with 3 spots, distal being larger, cell M_{3+4} with 1 spot near the fork and cell An having 1 irregular marking. In addition to the above, 1 linear dark streak runs along M_{1+2}. Squama with 14 setae. Haltere brown. CR 0.96, VR 1.05.

Legs: Yellow to brown in colour except dark brown femur. Fore tibial scale (Fig. 2) with 2 setae. LR 1.38 in fore, LR 0.6 in mid and LR 0.75 in hind legs. TR of hind leg 1.27.

Abdomen: Dark brown in colour. Segment VIII constricted at the base.

Hypopygium (Fig. 3): Anal point 0.08 mm long with 3 setae on each side. Gonocoxite well developed having 10-12 setae; gonostylus little swollen bearing 12 small setae along its inner apical margin. Appendage 1 bare, filamentous and bent at tip, appendage 2 outwardly bent with 10 apical incurved setae.

FEMALE: Body length 2.78 mm, wing length 1.72 mm and breadth 0.57 mm.

Similar to male with usual sex differences. Antenna yellow except dark brown flagellomere V, length ratio of flagellomeres I-V 23:18; 20:19:38, AR 0.48. *Genitalia* (Fig. 4): Notum 0.19 mm long. Coxosternapodeme S shaped. Gonapophysis VIII divided into long dorsomesal lobe (Fig. 5) and a stout ventrolateral lobe (Fig. 6). Apodeme lobe (Fig. 7) weak. Gonocoxite IX with 2 setae. Postgenital plate V shaped. Seminal capsules rounded, ducts of seminal capsules joined together before opening to the vagina.

Material examined: *Holotype* ♂ (Type no. 104, B.U. Ent.), Kakdwip, West Bengal, 11.xi.1978, Coll. A. K. Chatterjee. *Allotype* ♀, data same as holotype. *Paratypes* 5 ♂♂, 3 ♀♀, Burdwan, West Bengal,, 23-26, x.1979, Coll. M. Ghosh; 2 ♂♂, Pasighat, Arunachal Pradesh, 2.viii.1979, Coll. B. Bhuiyan. Types and paratypes are in the collections of insects in the University of Burdwan.

This species appears to be close to *Polypedilum nubifer* (Skuse) from Formosa, Sri Lanka, Africa, Australia and Japan in respect of some aspects of wing, leg and male hypopygium. It shows affinity to *P. bruneicornis* Kieffer from African Countries in anal point and gonostylus and with *P. annulatum* Freeman (1958) from Sudan in wing spots, chaetotaxy of thorax and hypopygeal features. But the characters like details of wing markings and hypopygium of male clearly distinguish it as a new member of the genus *Polypedilum* Kieffer.

ACKNOWLEDGEMENT

Sincere thanks are due to the Head of the Department of Zoology, University of Burdwan for laboratory facilities.

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ON A NEW SPECIES OF THE GENUS *IRDEX* BURR (DERMAPTERA: LABIIDAE) FROM SRI LANKA[1]

G. K. SRIVASTAVA[2]

(*With six text-figures*)

Through the kindness of Dr. Karl V. Krombein, Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A., I received for study four specimens of Dermaptera which were collected during the course of a field project, "Biosystematic studies of insects of Ceylon". Of these one male representing a new species is described below.

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[1] Accepted January 1982.

[2] Zoological Survey of India, Calcutta.

Irdex ceylonensis sp. nov.

MALE: General colour yellowish brown, antennae lighter, sides of pronotum, mouth parts and legs yellow, elytra in middle somewhat lighter in colour, wings at base with a transverse, yellow stripe and forceps with tip black. Body covered with long and short pubescence.

Head slightly longer than broad, frons moderately convex, sutures obsolete, hind margin emarginate in middle. Eyes about as long as post-ocular length. Antennae (partly broken; three segments on the left and nine on the right remaining) with 1st segment stout, narrowed basally, slightly shorter than the distance between antennal bases; 2nd small; 3rd long and cylindrical; 4th gently expanded apically and slightly shorter than the preceding; 5th as long as the 3rd but stouter, remaining thinner and gradually increasing in length. Pronotum trapezoidal, about as long as broad, anteriorly and laterally straight, latter feebly reflexed, strongly diverging posteriorly, hind angles and margin well rounded, median sulcus finely marked; prozona raised and well differentiated from flat metazona. Legs normal, hind tarsi with 1st segment slightly longer than the third. Elytra and wings well developed. Abdomen weakly convex, slightly enlarged posteriorly. Penultimate sternite transverse, broadly rounded posteriorly with slight emargination in middle. Ultimate tergite transverse, depressed, sides straight, hind margin faintly trisinuate, feebly oblique laterally. Pygidium strongly declivous and convex at base, afterwards forming a horizontal plate, oval in shape, laterally in the middle provided with a sharp, posteriorly directed minute tooth, hind margin deeply marginate with angles produced into minute point. Forceps remote at base, depressed, tapering apically, gently curving in middle, apices gently hooked and pointed, internal margin ventrally sharp with minute teeth in middle, armed with one or two larger and triangular teeth in apical one third. Genitalia as in figs. 4 and 5.

FEMALE: Unknown.

Measurements (in mm): Holotype ♂: Length of head 1.4; Width of head 1.2; Length of eye 0.39; Post-ocular length 0.39; Length of 1st antennal segment 0.52; Distance between antennal bases 0.57; Length of pronotum 1.3; Width of pronotum 1.25; Length of elytra 1.9; Length of wing 1.1; Length of ultimate tergite 0.9; Width of ultimate tergite 1.7; Length of pygidium 8.5; Width of pygidium 0.6; Length of body 7.6; Length of forceps 3.0.

Material examined. SRI LANKA: Rat. Dist., Gilimale, Induruwa jungle, collected near Kaluganga, Holotype ♂ (genitalia mounted between two coverslips and pinned with the specimen), 5-7 February, 1977, Coll. K. V. Krombein and party; Type No. 100312, deposited in Museum of Natural History, Smithsonian Institution, Washington, D.C., U.S.A.

This species comes very close to *Irdex stella samsingensis* Srivastava (1975) from India (Darjeeling Dist.) but differs in the shape of the pronotum being distinctly widened posteriorly (vs. sides parallel or a trifle widened posteriorly in *I. s. samsingensis*); pygidium with lateral margin beyond lateral tubercle gently convex (vs. lateral margin straight); forceps stouter, armed internally below in apical one third with one or two sharp teeth (vs. slender; armed internally along the ventral margin with sharp serrations in apical one third and dorsally with two minute teeth in basal two third and a larger teeth at apical one third) and ♂ genitalia with parameres enlarged in middle with external margin convex and virga longer (vs. parameres almost of uniform width, straight and virga comparatively shorter, fig. 6).

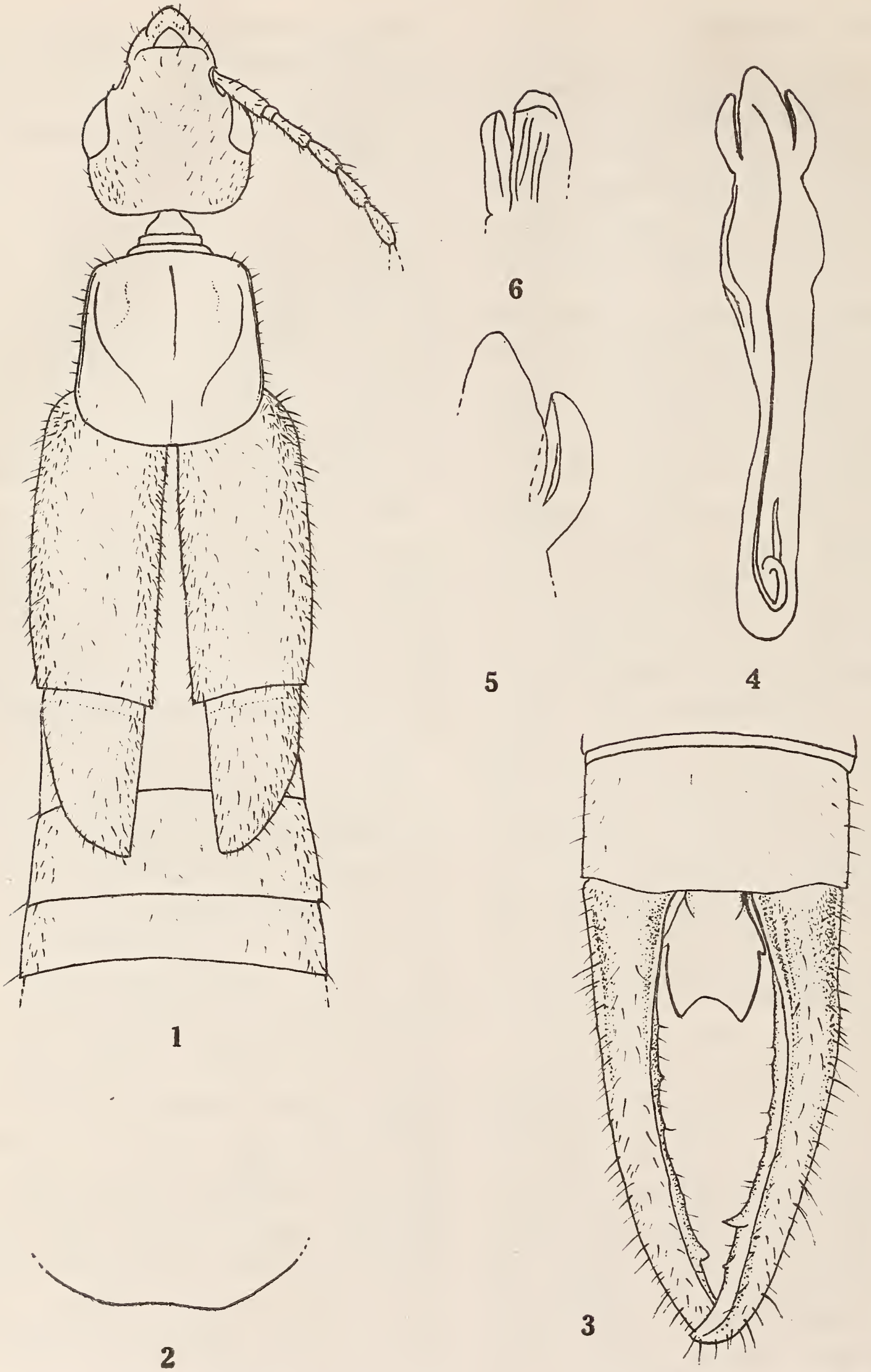

Fig. 1-6: *Irdex ceylonensis* sp. nov., Holotype ♂; 1. Anterior portion of body, legs and antenna of one side not shown; 2. Posterior margin of penultimate sternite; 3. Ultimate tergite and forceps; 4 Genitalia; 5. Paramere of one side only enlarged. *Irdex stella samsingensis* Srivastava, Holotype ♂; 6. Paramere of one side only, enlarged.

ACKNOWLEDGEMENTS

I am thankful to the Director, Zoological Survey of India, Calcutta for necessary facilities and to Dr. Karl V. Krombein, Natural History Museum, Smithsonian Institution, Washington, D.C., U.S.A. for placing this material at my disposal.

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A NEW SPECIES OF *ANEMONE* L. (RANUNCULACEAE) FROM TEHRI DISTRICT (GARHWAL) IN INDIA[1]

A. K. GOEL AND U. C. BHATTACHARYYA[2]

(*With seven text-figures*)

During the course of studies on "Herbaceous Flora of Tehri District (Garhwal)" a taxon belonging to the genus *Anemone* L. was collected from Gangi (3000 m) in August 1978. A critical study of literature and herbaria shows that it is taxonomically distinct from any other known species of *Anemone* L. and is being described as new.

Anemone raui sp. nov.

A. elongatae D. Don affinis, sed different foliis majoribus, 9-18 (-20) cm daim, floribus in cymis dischasialibus, perianthio anguste obovate, parviore, 9-15 x 4-6 mm, staminibus 20-35, pistillis 3-6, acheniis 1-4, elliptico-ovatis, rostro parum curvato, seminibusque glabris.

Holotypus lectus ad locum Gangi, 3000 m, Garhwal, die 12-8-1978, *A. K. Goel* 64419-A, et positus in herbario BSD.

Herbae erectae, 50-75 cm altae, 0.4-0.6 cm crassae, caudex perennis. Caulis 30-50 cm longus, basi validus, petiolorum fibrosis reliquiis tectus, glaber, villosus ad articulos involucrales. Folia radicalia longipetiolata, petioli 12-32 cm longi, anguste vaginantes ad basin; lamina 9-18 (-20) cm diam, palmatim 3-loba, pentitus cordata, subglabra, pilosa praesertim in nervis, segmenta sessilia, inaequaliter late obovata, profunde vel non profunde 3-partita, cuneata, 5-10 x 4.5-9 cm; segmenta secundaria denuo 3-loba, irregulariter grosse serrata. Inflorescentia varie divisa cyma dichasialis, haud umbella. Involucrum ordinis primi-2, sessile, utrinque 3-5 x 4-6 cm, late obovatum, cuneatum, subglabrum, utrinque pilosum in nervis, segmenta trifida, cuneata, unumquidque segmentum 3-lobum, irregulariter serratum; involucrum ordinis secundi et ultra parvius, late obovatum, cuneatum, segmenta 3-loba, apice acuta, 1.5-3.0 cm longa; pedunculi 5-15 cm longi, pedicelli 2.5-8 cm longiis medianus semper parvior, sursum parum puberulus ad pubescens. Perianthium 5, anguste obovatum, 9-15 x 4-6 mm, album, glabrum. Stamina 20-35, filamenta 1.5-3 mm longa, complanata ad filiformia, inaequalia, antherae 0.8-1.2 mm longae, anthera exterior lineari elliptica, ea interior late obovata. Pistilla 3-6, sessilia, 3.0-3.5 mm longa,

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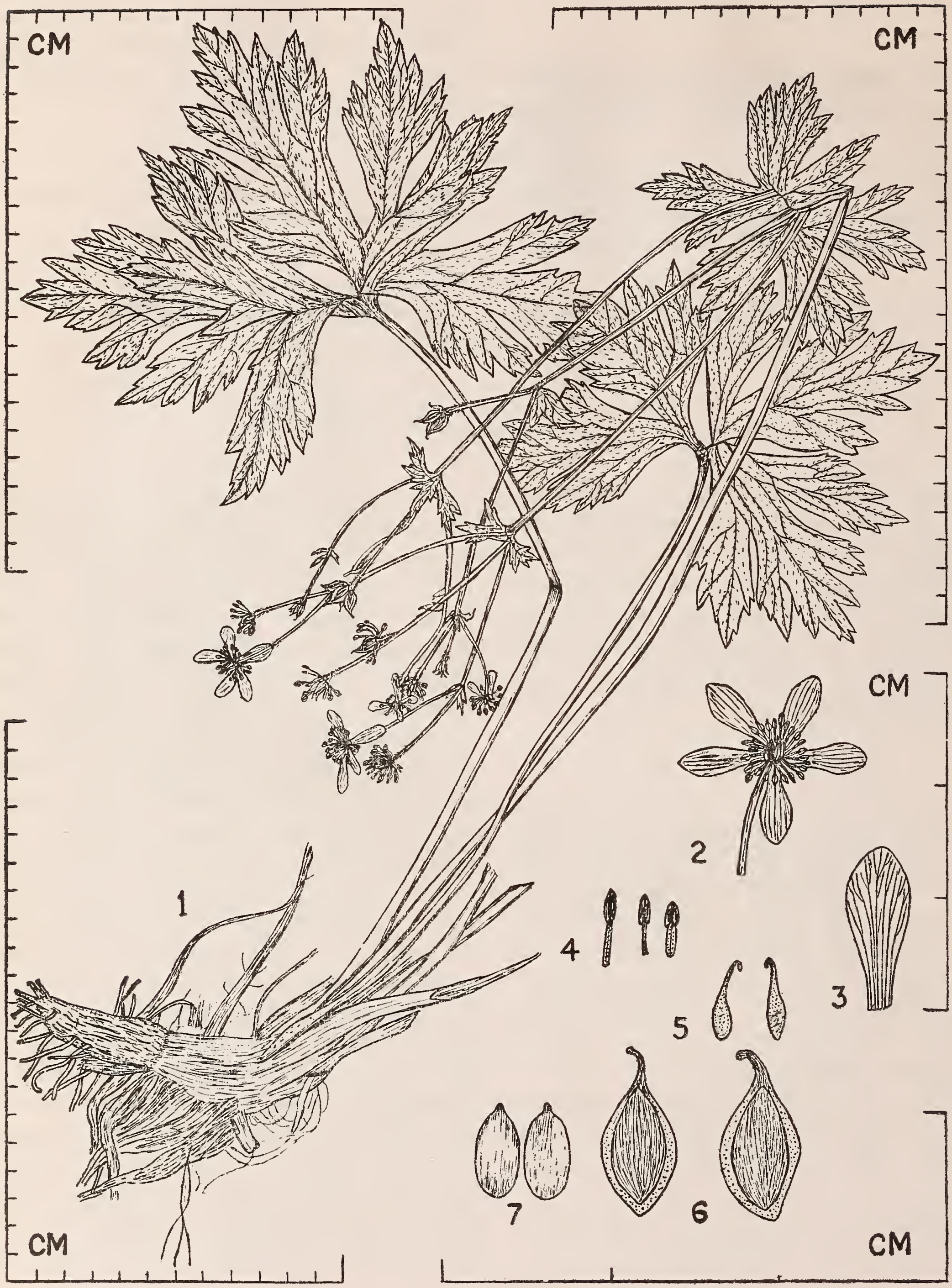
[1] Accepted March 1982.

[2] Northern Circle, Botanical Survey of India, 3, Lakshmi Road, Dehra Dun, (U.P.).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Figs. 1-7. *Anemone raui* sp. nov.: 1. Habit; 2. Flower; 3. Petal; 4. Stamens; 5. Gynoecia; 6. Achenes; 7. Seeds. (*Goel* 64419A, BSD).

glabra, ovarium compressum, lineari-ovatum, stylo leniter curvato, in stigmatis apice obtusum angustato. Achenia, maturitates attingentes, pauca (1-4), plana, elliptico-ovata, 5-7 x 3-4 mm, symmetrica. Stylus persistens, parum curvus, ad achenium contiguous, anguste marginatus. Semina plana, 5-6 x 2.5 mm, late lanceolata, atro-brunnea, glabra.

Anemone raui sp. nov.

Allied to *Anemone elongata* D. Don, but differs in its large 9-18 (-20) cm across leaves; inflorescence a dichasial cyme; perianth narrowly obovate, smaller, 9-15 x 4-6 mm; stamens 20-35; pistils 3-6; achenes 1-4, elliptic-ovate beak slightly curved. Seeds glabrous.

Holotype: GARHWAL: Gangi 3000 m, 12-8-1978; *A. K. Goel* 64419-A, deposited at the Herbarium of the Botanical Survey of India, Northern Circle, Dehra Dun (BSD).

Erect herbs 50-75 cm high, 0.4-0.6 cm thick; root stock perennial. Stem 30-50 cm long, base stout covered with fibrous remains of petioles, glabrous, villous at involucral joints. Radical leaves long petiolate; petioles 12-32 cm long, narrowly sheathing at base; lamina 9-18 (-20) cm across, palmately 3-lobed, deeply cordate, subglabrous, hairy chiefly on nerves; segments sessile, unequally broadly obovate, deeply or shallowly 3-partite, cuneate, 5-10 x 4.5-9 cm; secondary segments again 3-lobed, irregularly coarsely serrate. Inflorescence a variously divided lax dichasial cyme, never in umbels. Involucres of first order-2, sessile, each 3-5 x 4-6 cm; broadly obovate, cuneate, subglabrous, hairy on nerves on both surfaces; segments trifid, cuneate, each segment 3-lobed, irregularly serrate; involucres of the second order and above, smaller, broadly obovate, cuneate, segments 3-lobed with acute apex. 1.5-3.0 cm long; peduncles 5-15 cm long. Pedicels 2.5-8 cm long; median always smaller, slightly puberulus to pubescent above. Perianth-5, narrowly obovate, 9-15 x 4-6 mm, white, glabrous. Stamens 20-35; filaments 1.5-3.0 mm long. complanate to filiform, unequal, anthers 0.8-1.2 mm long; outer linear-elliptic, inner broadly ovate. Pistils 3-6, sessile, 3.0-3.5 mm long, glabrous, ovary compressed, linear-ovate with gently curved style, tapering into obtuse stigmatic apex. Achenes few (1-4) attaining maturity, flat, elliptic-ovate, 5-7 x 3-4 mm, symmetrical; style persistent, slightly curved, contiguous to achene, narrowly margined. Seeds flat, 5-6 x 2.5 mm long, broadly lanceolate, dark brown glabrous.

Type: GARHWAL: Gangi 3000 m, 12-8-1978; *A. K. Goel* 64419-A (Holotype-BSD); KUMAON: Below Odiyar 2900 m, 8-8-1972, *C. M. Arora* 49738 (Paratype-BSD); Below Odiyar 3300 m, 6-8-1972, *C. M. Arora* 49636 (Paratype-BSD).

Flowers & Fruits: July-September.

Distribution: INDIA: Garhwal and Kumaon Himalaya in Uttar Pradesh.

Ecology: Common on open grassy slopes, between rocks and near streams in temperate regions.

Etymology: The species has been named in honour of Dr. M. A. Rau, a well known botanist, plant explorer and retired Deputy Director, Botanical Survey of India, Northern Circle, Dehra Dun.

ACKNOWLEDGEMENTS

We are thankful to the Director, Botanical Survey of India, Howrah for encouragement and to Dr. N. C. Majumdar, Systematic Botanist, Botanical Survey of India, Howrah, for providing the latin diagnosis.

NEW TAXA OF *OPHIORRHIZA* L. (RUBIACEAE)[1]

D. B. Deb and D. C. Mondal[2]

(*With two text-figures*)

Ophiorrhiza nepalensis sp. nov.

Differt ab *O. heterostyla* Dunn foliis latioribus, apice breviter acuminatis, pedunculis confertim pilosis, floribus parvioribus, corollae lobis tubos similibus, pollinis granis suboblatis.

Typus. East Nepalia, *J. D. A. Stainton* 6881 (Holotypus BM).

This is allied to *O. heterostyla* Dunn, differing in broader leaves, shortly acuminate leaf apex, densely hairy peduncle, smaller flowers, corolla lobes as long as the tube and suboblate pollen grains.

Herbs with woody base, branching, about 50 cm tall; stem terete, quadrangular and pubescent when young. *Leaves* petiolate, 7-14 x 2-4.5 cm, elliptic or lanceolate, acuminate, entire, attenuate at the base, glabrous above, pubescent on the nerves beneath; nerves subopposite, 7-11 on either side; petioles 0.5-1 cm long, pubescent; stipules 4-8 mm long, subulate, entire or bifid above, puberulous. *Inflorescence* terminal and at the upper axils, dichotomously branched corymbose cymes, sometimes the ultimate branches helicoid; peduncles 1-2 cm long, pilose. *Flowers* pedicellate, bracteate, bracteolate, 6-8 mm long, pale green; pedicels 0.6-0.8 mm long, puberulous; bracts and bracteoles minute. *Hypanthium* 0.6-0.75 x 0.8-1 mm, ribbed, puberulous; calyx lobes 5, ovate, 0.5-0.75 x 0.4-0.6 mm, acute, puberulous. *Corolla* 5.25-7 mm long, tube cylindric, glabrous outside; lobes 5, linear, as long as the tube, acute at the apex, inwardly curved, strongly keeled at the back, sparsely hairy inside with a villous ring at the throat. *Stamens* 5, epipetalous, adnate to 1/3rd the length of the corolla tube, exserted; filaments 3.5-4 mm long, glabrous; anthers 1.25-1.5 mm long, linear, bilobed, dorsifixed, introrse, dehiscing longitudinally; pollen grains suboblate, semiangular in polar outline, polar axis (P) x equatorial axis (E) = 29-(31)-32 x 35-(36)-38 μm, tricolporate, colpi 28-30 x 5-5.5 μm, tapering to acute ends; ora circular, 5.25-6.25 μm in diameter; exine 1.75-1.8 μm, sexine 1.5-1.6 μm, nexine 0.25 μm ruguloreticulate; lumina 0.6-0.8 μm, muri 0.75 μm, *Ovary* 0.5-0.6 x 0.75-0.8 mm, obovoid, 2-loculed, with many ovules in each locule on exile placenta; disc 0.4-0.5 mm thick, fleshy, 2-lobed; style 1.5-1.75 mm long, glabrous; stigma 2-lobed, 0.75-1 mm long, lobes lanceolate, acuminate, puberulous. *Capsule* 2-3 x 5-8 mm, obcordate, compressed, with a thickened band in the middle, puberulous, internally 2-locular, angle of divergence of the locule with the midseptum 55°-60°, locules ovate-oblong, tip slightly curved outwards, dehiscing loculicidally. *Seeds* numerous in each locule, irregularly angular, 0.3-0.4 x 0.25-0.3 mm, surface glabrous, brown; testa areolate, areoles alveolate, wall of the areole thick with a number of globules on it or hooded over the areolar space.

Type: East Nepal, Soktim Tea Estate, 450 m, 22nd May, 1971, *J. D. A. Stainton* 6881 (Holotype BM).

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[1] Accepted April 1982.

[2] Botanical Survey of India, Indian Botanic Garden, Howrah-711 103.

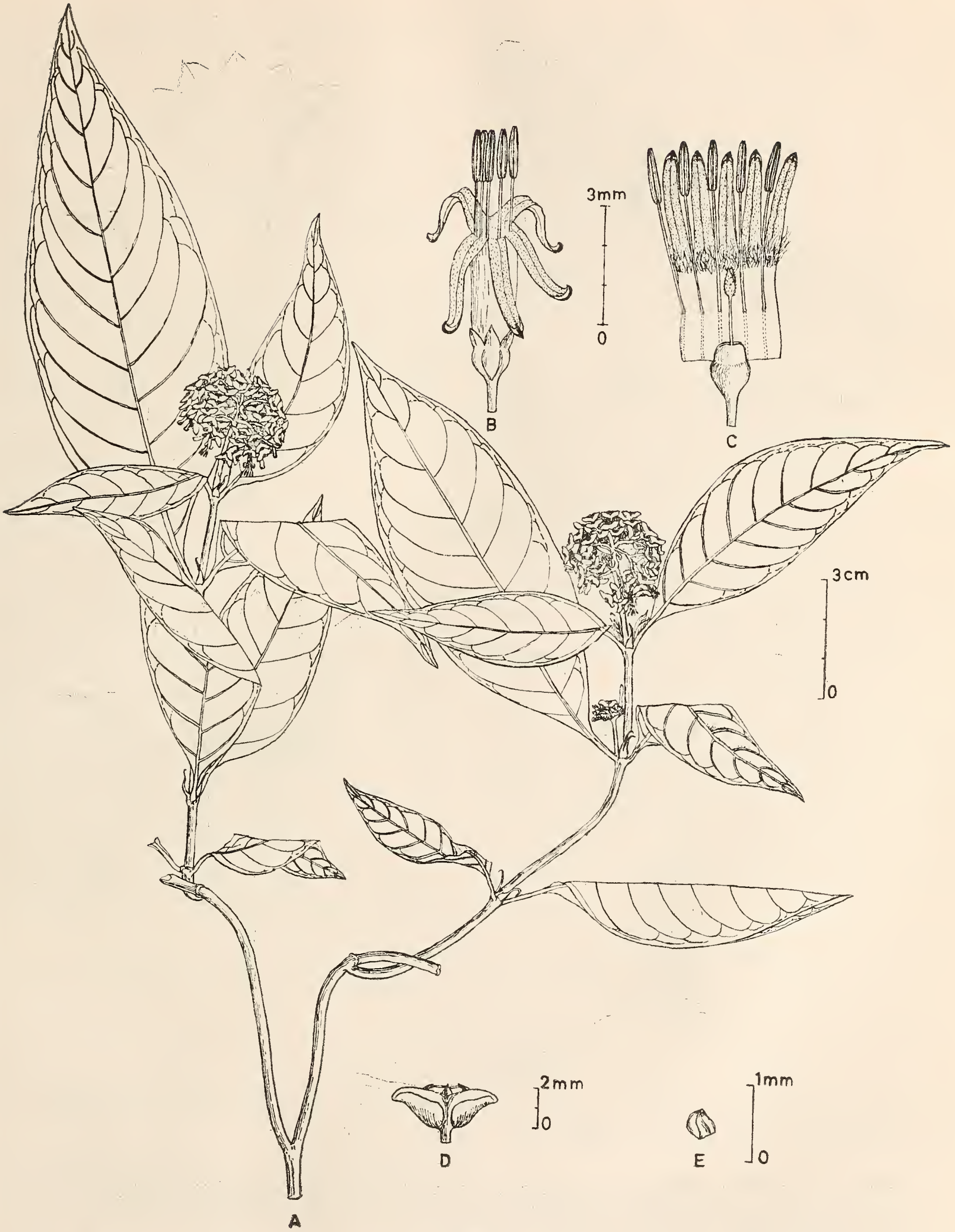
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Fig. 1. *O. nepalensis* **sp. nov.**: A. habit; B. flower outer view showing calyx, corolla and androecium; C. flower split open; D. fruit; E. seed.

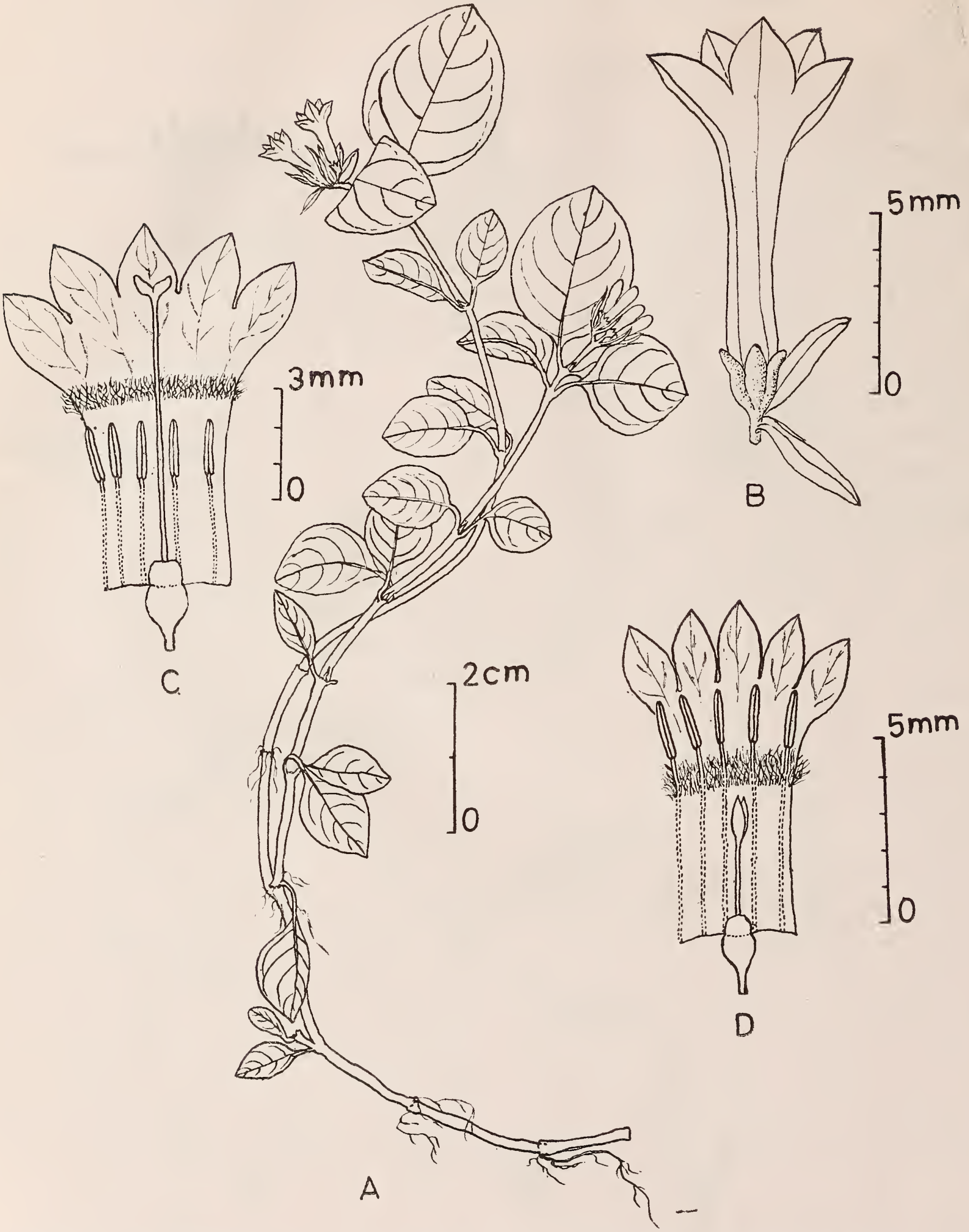

Fig. 2. *O. pauciflora Hook f.* var. *glabra* var. nov.: A. habit; B. flower showing calyx and bracteole; C. flower split open showing long style and short stamens; D. flower split open showing short style and long stamens.

Growing in shady places at about 450 m in East Nepal.

O. pauciflora Hook f. var. **glabra** var. nov.

A varietate typica, differt in cymis floralibus partibusque glabris, floribus longioribus.

Typus. Arunachal, *F. Kingdon Ward* 8148 (Holotypus K).

Differing from the typical variety in glabrous cyme as well as floral parts and longer flowers.

Herbs 12-25 cm long; creeping at the base, branching, slender, pubescent. *Leaves* petiolate, 0.8-2.0 x 0.5-1.8 cm, ovate or oblong, obtuse at the apex, obtuse or slightly attenuated at the base, glabrous or with scattered short hairs above; lateral nerves 4-6 on either side, subopposite, pubescent beneath; petioles 0.3-2 cm long, pubescent; stipules 2-3 mm long, linear, entire, sometimes bifid, glabrous. *Inflorescence* terminal cyme, 0.5-1 cm across, glabrous. *Flowers* pedicellate, bracteate, bracteolate, 10-12 mm long, tubular, white; pedicels 0.5-1 mm long, glabrous; bracts 5-6 mm long, linear, with prominent midrib, acute, glabrous; bracteoles 3-5 mm long, linear, with prominent, midrib, acute, glabrous. *Hypanthium* 0.9-1.4 x 1-1.5 mm, obovoid, glabrous; calyx lobes 0.8-1 x 0.6-0.75 mm, ovate, obtuse, glabrous. *Corolla* 9-11 mm long, tube cylindric, wide at the mouth, glabrous outside, villous at the middle or slightly above within; lobes 5, ovate, 2-3.25 x 1.25-2 mm, acute, glabrous. *Stamens* 5, epipetalous, adnate either above the base or above the middle of corolla, inserted; filaments 0.5-0.75 mm or 1-1.3 mm long, glabrous; anthers 1.25-1.3 mm long, glabrouse; anthers 1.25-1.3 mm long, linear, bilobed, dorsifixed, introrse, dehiscing longitudinally. *Ovary* 0.8-1.2 x 0.75-1.25 mm, obovoid, 2-locular, with many ovules in each locule on axile placenta; disc 0.5-0.7 mm high, fleshy, 2-lobed; style either as long as or 1/3rd of corolla tube, glabrous; stigma 2-lobed, 0.5-0.6 mm long and lobes ovate or 0.8-1.3 mm long and lobes ovate-lanceolate.

Type: Arunachal, Lohit district, Debi valley (28°20′N & 96°37′E), 1500-1800 m, 3.5.1928, *F. Kingdon-Ward* 8148 (Holotype K).

Note: One flower shows 6 stamens and minute style and stigma; style as long as the height of disc and stigma 0.5 mm long.

ACKNOWLEDGEMENTS

We are thankful to the Directors and Keepers, Royal Botanic Gardens, Kew and British Museum (Natural History), London for loan of specimens for the study, and to the Director, Botanical Survey of India, Howrah, for facilities and granting a scholarship to one of the authors (DCM).

INDIGOFERA TIRUNELVELICA — A NEW SPECIES FROM TAMIL NADU, S. INDIA[1]

M. SANJAPPA[2]

(*With nine text-figures*)

Indigofera tirunelvelica sp. nov.

I. glandulosa Roxb. ex Willd. affinis sed differt leguminibus complanatis non altis acute rostratis, valvis prominenter nervatis, seminibus parvis, pedunculis fructiferis brevioribus.

Holotypus lectus ad locum Tirunelveli, Tamil

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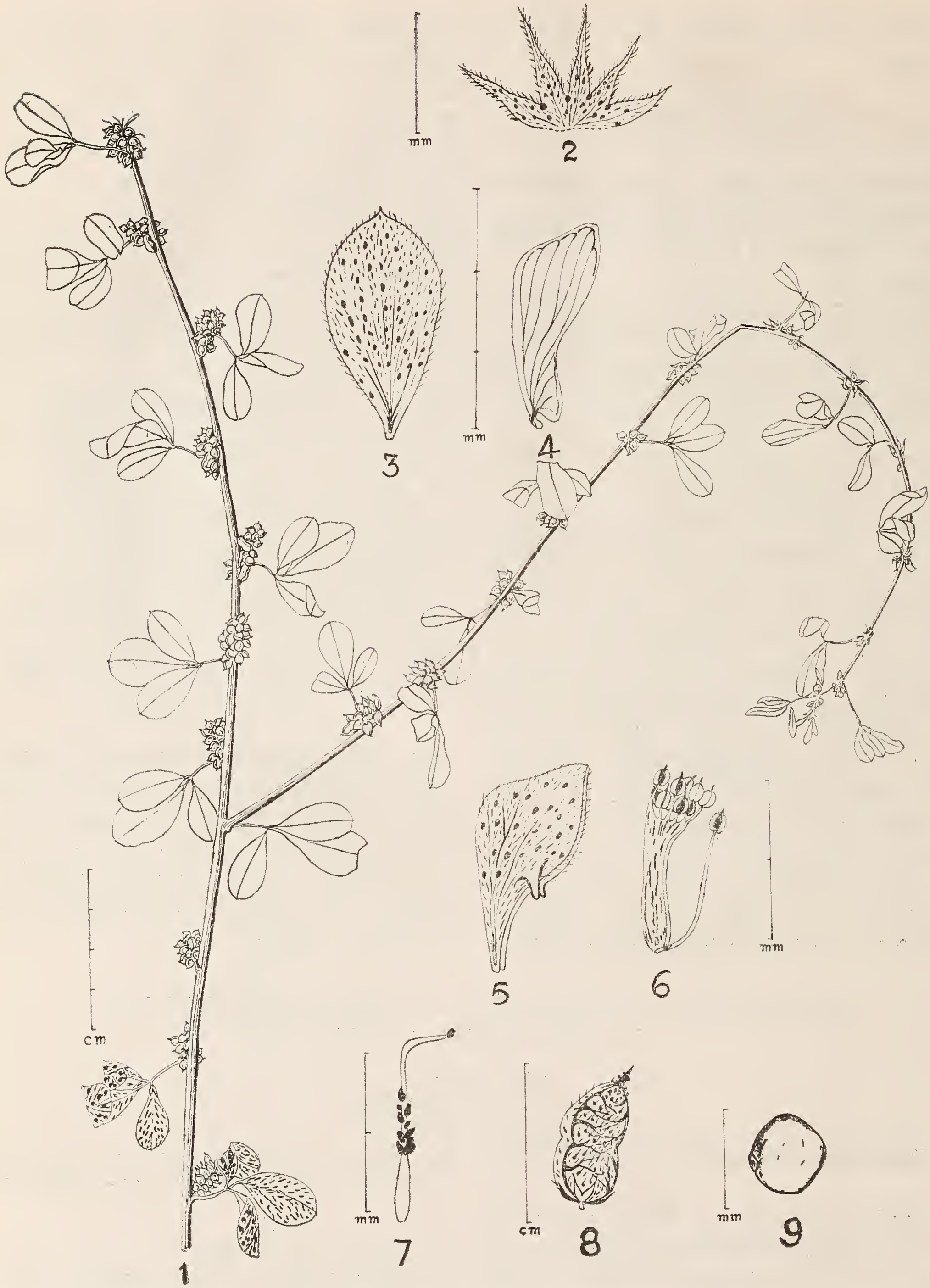
[1] Accepted April 1982.

[2] Botanical Survey of India, Howrah 711 103.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Figs. 1-9. *Indigofera tirunelvelica* sp. nov.: 1. A twig of the plant; 2. Calyx; 3. Standard; 4. Wing; 5. Keels; 6. Stamens; 7. Carpel (with glands at the base of style); 8. Pod; 9. Seed.

Nadu, secus viam, inter Kalkad et Sengalteri, 330 m, die 18 December 1980, a *M. Sanjappa* 717*A*, et positus in herbario CAL. Isotopi *M. Sanjappa* 717*B-F* positi in eodem herbario.

Indigofera tirunelvelica sp. nov.

Allied to *I. glandulosa* Roxb. ex Willd. but differs from it in having pods flattened, wingless, sharply beaked, prominently veined on valves, seeds small, fruiting peduncles shorter.

Annual, erect herbs, about 60 cm high; branches woody, angular, light brown pubescent when young, terete, striate and glabrous at maturity. Leaves 3.5-4 cm long, pinnately trifoliolate, alternate; petioles 1-1.3 cm long, slender, canaliculate above, pubescent, glandular; leaflets (10-) 15-20 (-25) x (5-) 10-15 mm: terminal leaflet larger, obovate or elliptic-obovate, base obtuse or cuneate, apex obtuse to rounded, mucronulate, uniformly adpressed pubescent on both surfaces; brown punctate-glandular beneath; stipules 0.8-1.2 mm long, subulate, pubescent without, stipels absent; petiolules 1 mm long pubescent. Racemes 5-10 mm long, axillary, sessile, rachis pubescent, glandular, elongating in fruits, upto 20-flowered. Flowers pink, 5 mm long; pedicels short, pubescent, glandular; bracts 1-1.5 mm long, lanceolate, acute, pubescent without, caducous; calyx 2 mm long, 5-lobed, lobes 1-1.5 mm long, adpressed pubescent and glandular without, tube less than 1 mm long; standard 3-5 x 1-1.2 mm, obovate or elliptic, mucronulate, pubescent and glandular without, wings 3-4.5 mm long, obliquely oblong, shortly clawed at base, obtuse at apex, glabrous; keels 3-5 mm long, spathulate, pubescent and glandular without, spurred, spur 1-1.5 mm long, hyaline; stamens diadelphous (9+1), standard stamen free to the base, filaments alternately long and short, anthers apiculate; ovary 1-1.5 mm long, glabrous, 1-2-ovuled; style 1.5 mm long, glandular at base, stigma capitate. Pods 3-6 x 2-2.5 mm, oblong, flattened, slightly torulose, sharply beaked, upper suture broader, valves prominently veined, adpressed pubescent, glandular; seeds 1 mm across, reddish-brown variously shaped, generally ellipsoid, often truncate at one end.

Flowering: November-December.
Fruiting: December-March.

Distribution: Tirunelveli Hills, Tamil Nadu.

Specimens examined: INDIA: TAMIL NADU, Tirunelveli Dist. along the roadside, between Kalakkad and Sengalteri, Alt. 300 m, 18 Dec. 1980, *M. Sanjappa* 717*A* (CAL, holotype); *M. Sanjappa* 717*B-F* (CAL, Isotypes); Sengalteri to Kalakkad, Alt. 1000 m, 16 Feb. 1913 *Hooper and Ramaswami* 39230 (CAL); Near Tiger Falls — way to Mancholai, Alt. 333 m, 4 Mar. 1958 *K. M. Sebastine* 5520 (CAL, MH); "Peninsulae Indiae Orientales" (without locality) *R. Wight s.n.* (Royal Garden, Kew distribution no. 651-CAL).

Etymology: This species is named after the type locality Tirunelveli ("Tinnevelly") district, Tamil Nadu, India.

ACKNOWLEDGEMENTS

I am thankful to Director, Botanical Survey of India, Howrah for providing facilities and to Dr. K. Thothathri, Deputy Director, Central National Herbarium, Howrah for encouragement. My thanks are also due to Dr. N. C. Majumdar, Systematic Botanist, Botanical Survey of India, Howrah for rendering diagnosis into Latin.

A NEW SPECIES OF *ELAPHOGLOSSUM* FROM INDIA[1]

Anjali Biswas and S. R. Ghosh[2]

(*With five text-figures*)

During the revisionary studies on the genus *Elaphoglossum* from India, we came across a few specimens, collected by Dr. King's collector and G. Mann from Jowai, Assam and noted as *Elaphoglossum conforme*. These after careful study turn out to be a new species of *Elaphoglossum*.

This new species differs from *Elaphoglossum conforme* Sw. in the following characters: (1) Rhizome short creeping with dark brown linear lanceolate scales, (2) Lamina base not decurrent on the stipe, (3) Stipe not filiform.

The new species comes nearer to *Elaphoglossum stelligerum* (Wall. ex Bak.) T. Moore ex Alston et Bonner but differs from it in the following characters. Presence of short armed stellate scale on the stipe which are adherent to the surface; base of the stipe black; Lamina oblong-lanceolate; apex of the lamina acuminate, base shortly cuneate, not decurrent on the stipe. Lower surface and midrib with minute dark brown long armed stellate scale which are closely adherent to the surface; upper surface with pale stellate scales with long arms and adherent to the surface.

Elaphoglossum jowaiense sp. nov.

E. stelligerum (Wall. ex Bak.) T. Moore ex Alston et Bonner proxime affine, a quo differt squamis stellatis brevi-armatis in stipite, superficiei adhaerentibus, stipitis basi nigro, lamina oblongo-lanceolata, acuminata, basi cuneata sed non decurrenti in stipite, infra contaque squamis stellatis minutis atro-brunneis longi-armatis superficiei adhaerentibus, supra squamis stellatis pallidis longi-armatis, superficiei adhaerentibus.

Rhizome breve, reptans, squamis profunde brunneis, linear-lanceolatis tecta, ad marginem integra. Frondes in seriebus duabus in rhizomate, stipes frondis sterilis 9-20 cm longus squamatus, squamis brunneis brevi-armatis stellatis, superficiei adhaerentibus, basi nigellis, stipes frondis fertilis longus, squamatus, squamis brevi-armatis stellatis, lamina brunnea, oblongo-lanceolate, 25-45 cm longa, 2.5-3 cm lata ad medium, apice acuminata, basi breviter cuneata, sed non decurrens in stipite tenuis sed firma, ad marginem tenuis sine margine cartilaginea. Venae distintae infra. Costa valida, minus squamato, squamis minutis stellatis, breviarmatis, brunnies, superficiei adhaerentibus, supra squamata, squamis stellatis longiarmatis pallidioribus et superficiei adhaerentibus. Lamina fertilis in longiore.

Holotypus lectus collector Kingii ad locum Jowai, Assam, mense Augusti anni 1892 et positus in CAL sub numero accessione 25226.

Paratypus lectus G. Mann ad locum Jowaipunji, Assam, et positus in CAL sub numero accessione 25248.

Elaphoglossum jowaiense sp. nov.

Rhizome short creeping, covered with linear-lanceolate, deep brown scale with entire margin. Frond in two rows on the rhizome, stipe of sterile frond 9-20 cm long, brown blackish at base scaly with brown short armed stellate

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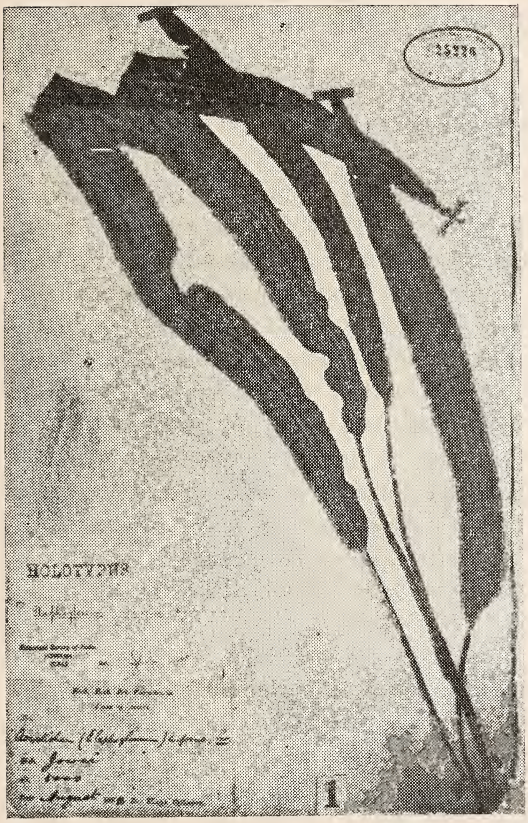
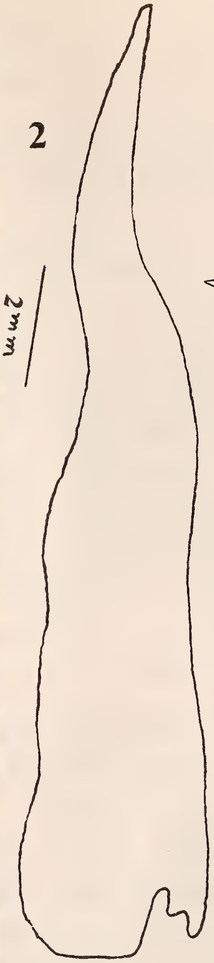
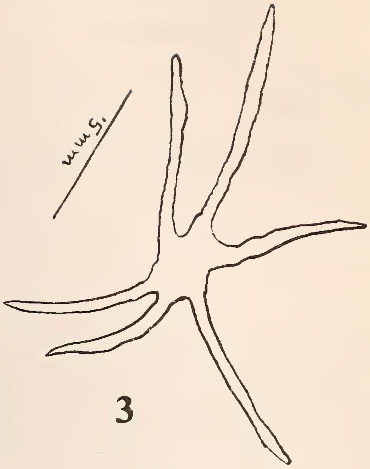
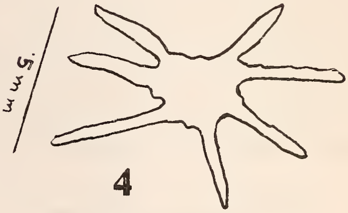
[1] Accepted January 1982.

[2] Botanical Survey of India, P. O. Botanic Garden, Howrah-711 103.









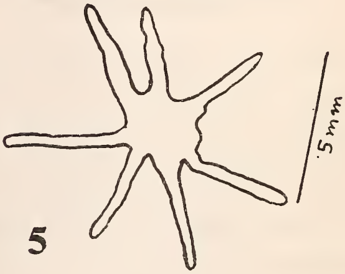


Fig. 1. Photograph of *Elaphoglossum jowaiense* sp. nov. Fig. 2. Rhizome scale. Fig. 3. Stellate scale from upper surface of lamina. Fig. 4. Stellate scale from lower surface of lamina. Fig. 5. Stellate scale from stipe.

scale which are adherent to surface, stipe of the fertile frond long, scaly with short armed stellate scales. Lamina brown coloured, oblong-lanceolate, 26-45 cm long, 2.5 to 3 cm broad at middle, apex acuminate, base shortly cuneate but not decurrent on the stipe, texture thin firm margin without cartilaginous border. Veins distinct on lower surface. Midrib stout, less scaly, scale minute, stellate with short arm, brown closely adherent to the surface; upper surface scaly, scale stellate with long arm, paler, and adherent to the surface, Fertile lamina on longer stipe, 20-25 cm long 1.5 cm broad, linear.

Holotype: Jowai, 1500 m, Assam, Aug. 1892. Dr. King's collector s.n. (CAL-25226).

Paratype: Jowai Pungi, 1500 m, Assam, G. Mann s.n. (CAL 25248).

ACKNOWLEDGEMENT

We express our gratitude to Dr. N. C. Mazumdar, Systematic Botanist, Central National Herbarium, Sibpur, Howrah for the latin description of the species.

MICROSTEGIUM BORIANUM SP. NOV. — (POACEAE) — A NEW SPECIES FROM INDIA[1]

P. R. SUR[2]

(*With a text-figure*)

Microstegium Nees was known to be represented in India by 6 species. One more new species has been found and named here *Microstegium borianum* sp. nov. from Meghalaya state, Khasia & Jaintia Hills, Lowlyngdoh. This new taxon is near to *M. petiolare* (Trin.) Bor but differs in less number of racemes (3-4), rudimentary pedicelled spikelet, lower floret empty, bifid palea of upper floret.

Microstegium borianum sp. nov.

Culms 128 cm long, tall stout, simple, glabrous, pubescent at the nodes and below the panicles. Leaves 25 cm long and 1.5-2 mm wide, lanceolate, acuminate, tubercle based hairs in both surfaces, ligules linear oblong, 2-4.5 mm long; leaf sheath pubescent. Inflorescence of 3-4 racemes, forming panicle, 5-10 cm long, axis glabrous. Sessile spikelet prominent, 5.5-6 mm long, lanceolate, oblong, pedicel ciliate; lower involucral glume 5.5 mm long, lanceolate, dorsally channelled, chartaceous, tip 2-toothed, 9 nerved, keels ciliate. Upper involucral glume 5.5 mm long, lanceolate acute, chartaceous, keel scabrid, 5 nerved, a small awn at the tip. Lower floret empty, lemma 4.5 mm long, lanceolate, toothed, middle of the margins ciliate, 3-nerved, hyaline; palea 3.5-4 mm long, oblong, hyaline, apex obtuse. Upper floret hermaphrodite; lemma 3.5-4 mm long, ovate oblong, membranous, hyalines, divided into two lobes from the middle, lobes, acute, glabrous, 3-nerved, awned from the sinus, awn 9-10 mm long; palea 3.5 mm long, linear lanceolate, hyaline, bifid, glabrous; stamens 3, anthers 3 mm long, filament small; ovary small, style long, filiform, stigma 2, plumose. Pedicelled spikelet rudimentary.

Holotype: India, Meghalaya, Khasia & Jaintia Hills, Lowlyngdoh, 26.9.1937, G. K. Deka 15683 (CAL).

Microstegium borianum sp. nov.

Differt a *M. petiolari* (Trin.) Bor racemorum numeris redactis (3-4), spicula majore, spicula pedicellata rudimentali, flosculo inferiore casso, flosculi superioris paleae apice bifido.

Culmi 128 cm longi, alti, validi, simpli, glabri, ad nodes infra paniculasque pilosi. Folia 25 cm longa, 1.5-2 mm lata, lanceolata, acuminata, utrinsecus pilosa, pilis basi tuberculatis, folii vagina pubescens. Racemi 3-4, paniculam formantes, 5-10 cm longi, axis glaber. Pedicellus ciliatus, spicula sessilis prominens, 5.5-6 mm longa, lanceolata, oblonga, gluma involucralis inferior 5.5 mm longa, lanceolata, dorsaliter canaliculata, chartacea, 9-nervis, apice

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[1] Accepted April 1982.

[2] Botanical Survey of India, Industrial Section, Indian Museum, Calcutta - 700 016.

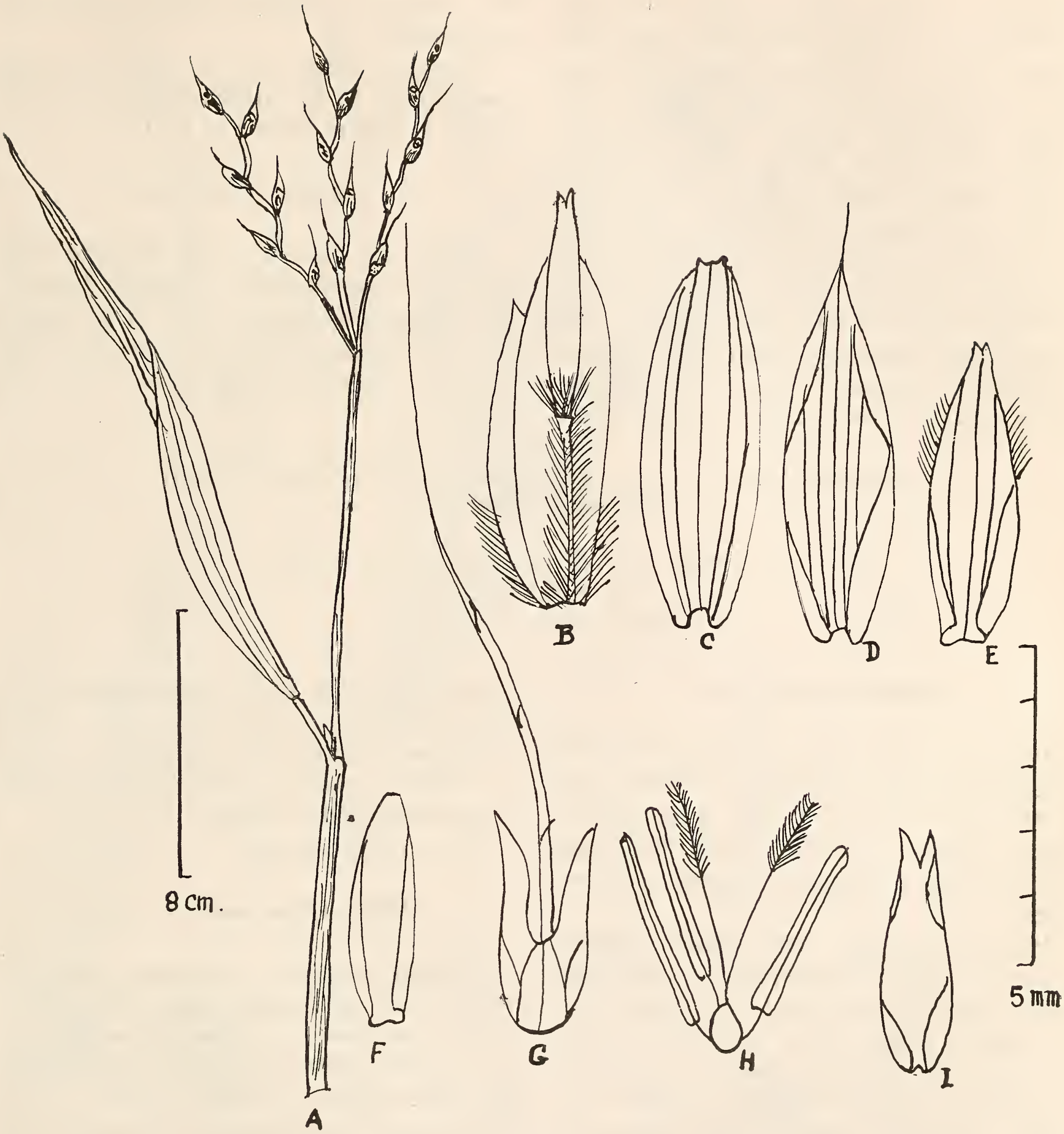
B
C
D
E
8 cm.
F
G
H
I
A
5 mm

Fig. 1. *Microstegium borianum* sp. nov.: A. Habit; B. Spikelet; C. Lower glume; D. Upper glume; E. Lower lemma; F. Palea; G. Upper floret; H. Stamens & Pistil; I. Palea.

bidentata, carinae ciliatae, gluma involucralis superior 5.5 mm longa, lanceolata, acuta, chartacea, 5-nervis, carinae scabridae, apice arista brevi. Flosculus inferior cassus; lamma 4.5 mm longa, lanceolata, dentata, 3-nervis, hyalina, margo ad medium ciliata; palea 3.5-4 mm longa, oblonga, hyalina, apice obtusa, flosculus superior bisexualis, lemma 3.5-4 mm longa, ovato-oblonga, membranacea, hyalina, a medio bilobata, lobi acuti, glabri, 3-nerves, a sino aristata, arista 9-10 mm longa, palea 3.5 mm longa, lineari-lanceolata, hyalina bifida, glabra; stamina 3, antherae 3 mm longae, filmenta parva, ovarium parvum, stylus longus filiformis, stigmata 2, plumosa. Spicula pedicellata rudimentalis.

Holotypus lectus a G. K. Deka ad locum Lawlyngdoh, K. & J. Hills, Meghalaya, India, die 26.9.1937 et positus in CAL.

ACKNOWLEDGEMENTS

I would like to express my gratitude to the Director of the Botanical Survey of India for the facilities provided and to Dr. N. C. Mazumder of the Central National Herbarium, Howrah, for valuable suggestions and Latin diagnosis.

SILENTVALLEYA — A NEW GENUS OF POACEAE FROM KERALA, INDIA[1]

V. J. NAIR, P. V. SREEKUMAR, E. VAJRAVELU
AND P. BHARGAVAN[2]

(*With eleven text-figures*)

Silentvalleya gen. nov.

Pertinet ad Eragrosteae e familia Poacearum et affinis *Diplachne* P. Beauv., sed differt spiculis lateraliter compressis; callus dense barbatis, glumis superis 3- nervatis, lemmatibus longe aristatis, nervis lateralibus glabris et inconspicuis

Plantae caespitosae et perennes. Laminae lineares. Ligulae membranaceae. Inflorescentiae effusae, aliquot racemis in axis une centralis. Racemi graciles, recti vel felxuosi. Spiculae ad nodi solitariae, biseriatae, lateraliter compressae, floribus 6-10, inter flosculos secedentes. Calli dense barbati. Glumae inaequales; glumae infernae inconspicuo 1- nervatae; glumae superae 3-nervatae. Lemmata glumis exserta, 3-nervata, nervi laterales glabri et inconspicui; apices integri, longe aristati. Paleae 2-nervatae, 2-carinatae. Lodiculae 2. Stamina 3. Stylo 2, stigmata plumosa. Caryopsides oblongo-lanceolatae, teretes.

Specia typica sequens:

Silentvalleya nairii sp. nov.

Gramina caespitosa et perennea. Culmi 40-100 cm alti, erecti; nodi glabri. Folia 40-60 x 0.4-0.6 cm, linearia, apicibus filiformibus, versus ores villosa aliter scabrida vel glabra. Vaginae spisse adligantes, rigidae, coriaceae, asperae et scabridae. Ligulae angustae, truncatae, membranaceae. Inflorescentiae paniculatae, 15-30 cm longae, 6-10 racemis, 8-20 cm longi, dispersis secus axes unos centrales. Spiculae oblongo-lanceolatae, *c.* 8 x 2 mm, 6-10 floribus, flosculo terminali redacto. Glumae in-

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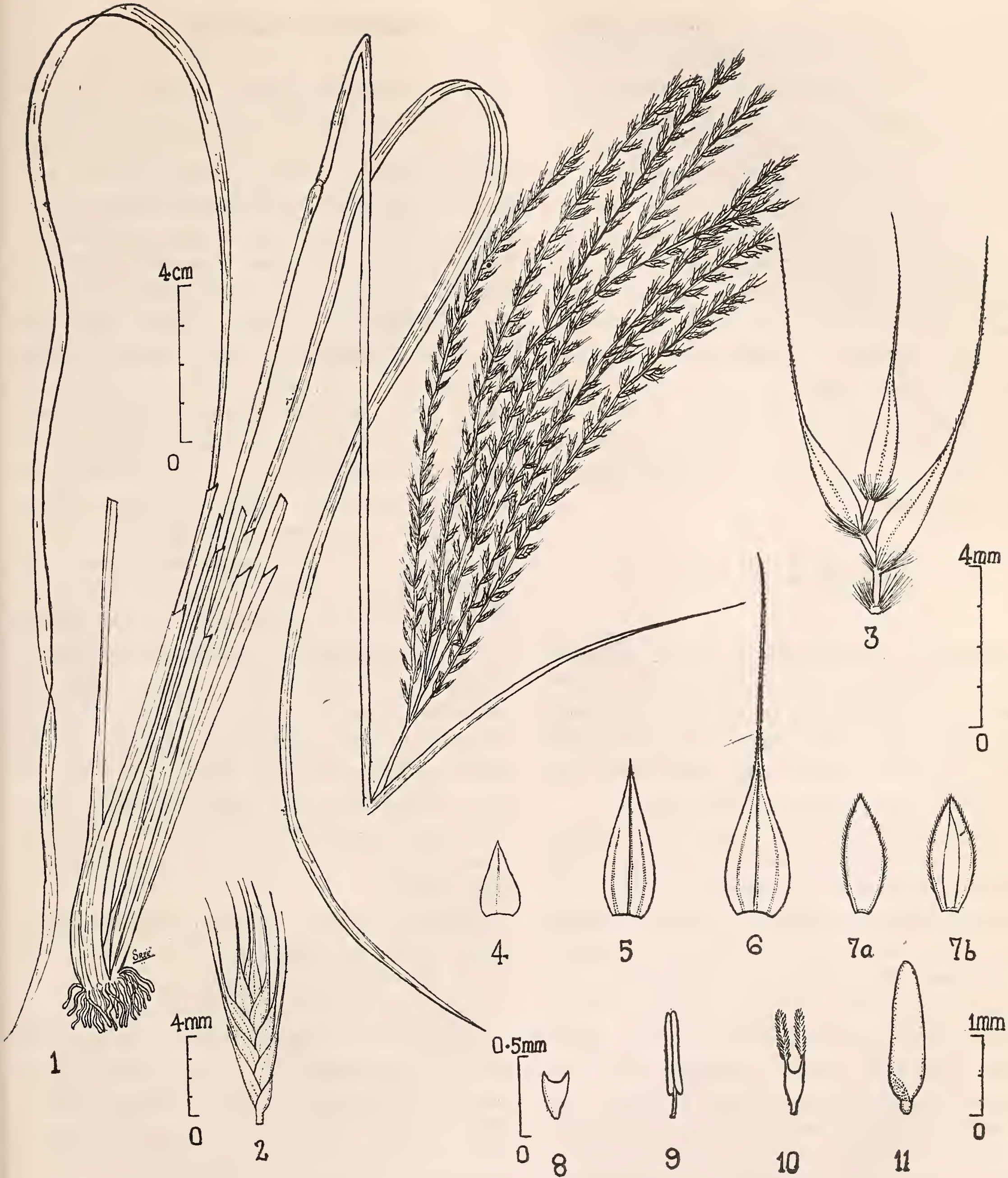
[1] Accepted March 1982.

[2] Botanical Survey of India, Coimbatore-3.


4cm
0
1
4mm
0
2
3
4mm
0
4
5
6
7a
7b
0·5mm
0
8
9
10
11
1mm
0

Figs. 1-11. *Silentvalleya nairii* gen. et sp. nov.: 1. Plant. 2. Spikelet. 3. Florets split apart to expose callus (semi diagramatic). 4. Lower glume. 5. Upper glume. 6. Lemma. 7a & b. Palea, dorsal and ventral views. 8. Lodicule. 9. Stamen. 10. Pistil. 11. Grain.

fernae *c.* 2 x 1 mm, ovatae, acutae, inconspicuo 1-nervatae, glabrae. Glumae superae *c.* 4 x 1.25 mm, lanceolatae, acuminatae, 3-nervatae, nervi laterales inconspicui et tantum manifesti ab dimidio inferno. Lemmata 4 x 1.75 mm, ovato-lanceolata, 3-nervata, nervis lateralibus inconspicuis; apex decinens in unam aristam; arista *c.* 5 mm longa, scabrida. Paleae *c.* 3 x 1 mm, ellipticae, glabrae, tenellae, 2-carinatae, carinis minute alatis et breviter ciliatis. Lodiculae 2, *c.* 0.3 x 0.15 mm, obovatae, apicibus 2-cornutis. Stamina 3, anthera *c.* 1.25 mm longa, fila brevia. Ovarium *c.* 0.4 x 0.25 mm, oblanceolatum, breviter stipitatum. Styli *c.* 0.3 mm longi. Stigmata *c.* 0.5 mm longa, plumosa. Caryopsides *c.* 2 x 0.4 mm, oblongo-lanceolatae, stipitatae.

Silentvalleya gen. nov.

Belongs to Eragrosteae of family Poaceae and is related to the genus *Diplachne* P. Beauv. from which it differs in the spikelet being laterally compressed; callus densely bearded, upper glume 3-nerved, lemma long awned and with the lateral nerves glabrous and faint.

Tufted perennial plants. Leaf blades linear. Ligules membranous. Inflorescence an open panicle with several racemes on a central axis. Racemes slender, straight or flexuous. Spikelets solitary at each node, biseriate, laterally compressed, 6-10 flowered, disarticulating between florets. Callus densely bearded. Glumes unequal; lower glume faintly 1-nerved, upper glume 3-nerved. Lemmas exserted from the glumes; tip entire, long awned; 3-nerved, lateral nerves glabrous and faint. Palea 2-nerved, 2-keeled. Lodicules 2. Stamens 3. Styles 2, stigmas plumose. Caryopsis oblong-lanceolate, terete.

Type species follows:

Silentvalleya nairii sp. nov.

Tufted perennial grasses. Culms 40-100 cm high, erect; nodes glabrous. Leaves 40-60 cm long, 0.4-0.6 cm wide, linear with filiform tips, tough, glaucous, villous towards mouth and scabrid or glabrous elsewhere. Sheaths closely fitting, rigid, coriaceous, rough and scabrid. Ligule a narrow truncate membrane. Inflorescence a panicle, 15-30 cm long, with 6-10 racemes scattered along a central axis, each 8-20 cm long. Spikelets *c.* 8 x 2 mm, oblong-lanceolate, 6-10 flowered with a terminal reduced floret, at times purplish. Lower glumes *c.* 2 x 1 mm, ovate, acute, faintly 1-nerved and glabrous. Upper glumes *c.* 4 x 1.25 mm, lanceolate, acuminate, 3-nerved, lateral nerves faint and visible only in the lower half. Lemmas *c.* 4 x 1.75 mm, ovate-lanceolate, 3-nerved, lateral nerves faint, tip ending in an awn 3-5 mm long which is scabrid. Paleas *c.* 3 x 1 mm, elliptic, 2-keeled, keels minutely winged and shortly ciliate, delicate, glabrous. Lodicules 2, each *c.* 0.3 x 0.15 mm, obovate, 2-horned at apex. Stamens 3; anthers *c.* 1.25 mm long, filaments short. Ovary *c.* 0.4 x 0.25 mm, oblanceolate and shortly stalked. Styles *c.* 0.3 mm long, stigmas *c.* 0.5 mm long, plumose. Grain *c.* 2 x 0.4 mm, oblong-lanceolate, stalked.

Holotype — INDIA—KERALA: Palghat District, Silent Valley dam site, ± 850 m, 5.10.1979, *N. C. Nair* 64268 (CAL).

Isotypes in MH (3 specimens).

Paratypes — Same locality, ± 700 m, 23.4.1980, *E. Vajravelu & V. J. Nair* 67260 (1 specimen in K, 4 specimens in MH); Palghat District, Silent Valley Reserve Forest, Aruvampara, ± 725 m, 10.10.1979, *N. C. Nair* 64465 (5 specimens in MH).

Grows in the crevices of rocks and other similar rocky areas. It is fairly common along the sides of Kunthipuzha river and forms large tufts on the boulders near the proposed Silent Valley dam site. It was also observed along the rocky slopes of Aruvampara but was less common.

The generic name denotes the type locality. The specific epithet is after Dr. N. C. Nair, the senior author's teacher and present Joint Director, Botanical Survey of India, Coimbatore in recognition of his valuable contributions to Indian Botany. His collections also form type materials of this taxon.

Dr. Thomas A. Cope, of the Herbarium, Royal Botanic Garden, Kew, after critical examination of our specimens gave the following opinion (personal communication), "........ is a new genus. It is, as you thought, related to *Diplachne* (but not to *Bewsia*), presumably derived from it. *Diplachne* is pantropical and has three awned derivatives. *Gouinia* in America, *Lophacme* in Africa and your new genus in India". We are very grateful to Dr. Cope for his constant help in our studies on the grasses of South India.

MISCELLANEOUS NOTES

1. INTRA-GENERIC TROOP FORMATION IN *PRESBYTIS* GENERA IN SANCTUARIES OF TAMIL NADU

At the first hair-pin bend while proceeding from Sethumadai up the Ghat road towards Topslip a bi-sexual Unimale troop of *Presbytis entellus* is seen. The troop composition was adult ♂, 3 adult ♀♀ and 3 infants on 11.3.77. One sub-adult *Presbytis johnii* was found in association with members of the above troop and appeared to have been well knit into the troop fabric. It was grooming other members including the adult ♂. On one occasion it held one grey infant. The habitat is transition from dry-deciduous to moist deciduous forest types, with trees about 20 m to 25 m tall with partially closed canopy, closely standing and with branches touching were distributed along the river course. The movement pattern of the troop coincided with the general distribution of trees around the river course. All observations were made near the road. The sub-adult *Presbytis johnii* continued to live (upto 23.2.81) with *Presbytis entellus* troop.

Two sub-adult *Presbytis entellus* have been associated since 3.5.78 with a troop of Nilgiri Langur (*Presbytis johnii*) near Erumaiparai. The habitat consists of trees of about 25 m tall generally situated far apart, with admixture of Bamboo clumps. Ground fire occurs as evidences indicate. The composition of *Presbytis johnii* troop is 1 adult ♂, 3 adult ♀♀ and 1 sub-adult ♀. The *Presbytis entellus* and *Presbytis johnii* were feeding, foraging, moving and resting together. Allogrooming only occurred between the two *Presbytis entellus*.

Mundanthurai Sanctuary

Near Manimuthar falls a *Presbytis entellus* troop composed of adult ♂, 3 adult ♀♀, 1 sub-adult ♀ and 3 infants has been accompanied by a sub-adult *Presbytis johnii* with a broken tail tip since 6.12.77. The habitat consists of trees and huge boulders.

In Mundanthurai in the vicinity of the Power House of Lower Dam, there has been a *Presbytis entellus* troop of 1 adult ♂, 5 adult ♀♀, 3 sub-adult ♀♀ and 3 infants since 1976. Almost always they can be found near the road. The habitat is bouldery with sparse and isolated trees, *Gyrocarpus* is frequently seen. The langurs can be seen either on the ground or on the boulders and parapet walls eating leaves of bushes. Grooming between of *Presbytis entellus* and *Presbytis johnii* was common. The *Presbytis johnii* was found also to hold grey infants on several times. When one sub-adult *Presbytis entellus* died, probably due to electrocution and fell between boulders, the *Presbytis entellus* troop with the sub-adult. *Presbytis johnii* remained around the carcass for 3 days. The carcass probably was dragged by a Panther into the boulders during the night. The sub-adult ♀ *Presbytis johnii* is a member of Koraiyar troop, with home range along the fringe of the forests o f moist deciduous trees on the Koraiyar banks. The troop was subjected to poaching and the troop was being slowly decimated.

In a nutshell composition of intra-generic troops

	Host troop Sp.	Guest Sp.	Age	Sex	No.
ANAMALAI SANCTUARY					
1. First Bend troop	P.e.	P.j.	SA		One
2. Erumaiparai	P.j.	P.e.	SA		Two
MUNDANTHURAI SANCTUARY					
3. Manimuthar Falls	P.e.	P.j.	SA		One
	P.e.	P.j.	SA		One
KALAKAD SANCTUARY					
5. Nambikoil	P.e.	P.j.	SA		One

The following parrellel situations can be considered.

1. The habitat was holding populations of both the species their home ranges overlapped.
2. The host troops are Bisexual Unimale troops.
3. Where as generally dry zone habitat *Presbytis entellus* are large here the host troops are composed of 5-12 members.
4. In all cases the guest is a sub-adult and female.
5. Whereas social grooming is not a common social interaction amidst *Presbytis johnii*, a considerable part of daily activity of *Presbytis entellus* involve mutual grooming! However, when the sub-adult *Presbytis johnii* got associated with *Presbytis entellus* they probably acquired this behaviour but the *Presbytis entellus* members of the *Presbytis johnii* troop groomed only among themselves and did not groom *Presbytis johnii*.
6. There have been no earlier records of members of other species living with *Presbytis entellus* except in one incident when a male Rhesus macaque probably an ciation of *Presbytis entellus* with *Presbytis entellus* group atleast for 7 years.
7. Considerable structural fluidity among groups, peridelic addition to and departure from, the group take place in *Presbytis entellus*. This may explain the association of *Presbytis entellus* with *Presbytis johnii*.

This may be a temporary phase only. Nevertheless this area opens up possibilities of future research.

J. MANGALARAJ JOHNSON

Wildlife Warden,
Kalakad Sanctuary,
Kalakad,
Tamil Nadu,
October 20, 1981.

2. THE CURIOUS DEATH OF A PANTHER

On 22nd February 1981, we spent a day in the Borivli National Park. At about 4 p.m., while returning we met a Forest Department jeep driving along the road with an iron cage on a trailer behind it. A Forest Ranger, whom I knew, was in the jeep and we stopped to exchange greetings. We were told that a panther had been trapped in a village near Padgha (Bhiwandi Taluka, Thane District) about 40 miles along the Agra Road and they were driving down to fetch it. This sounded an interesting project and we linked up with them.

A little before Padgha the jeep turned off toward the Mahuli Hills and after some tricky driving (at least for my Fiat) along a cart track we reached the village of Kalling. A large crowd of people indicated something of interest. We left our car about 50 yards away and walked up. The crowd was densely packed against a hut and we had to elbow our way through. The hut was the usual *Kathori* type, about 18 inches off ground level, the floor paved with cowdung and with the walls of Karvi (*Strobilanthes*) stalks. The Karvi wall on one side had been almost completely knocked down to exhibit a full-grown panther lying at the far end of the room which was perhaps 10′ x 10′. It was obviously very sick and looked helplessly at the crowd which had gathered to see it. It was indeed an extraordinary experience looking at an adult live panther at less than 20 feet with no bars in-between.

The forest jeep then manœuvered against another wall and they proposed to get the animal to walk into the cage. Upon my enquiring how the animal was to be persuaded and what was to be done in the event of its refusing to comply, I was told that some blankets had been sent for and that these would be thrown upon it if such a contingency should arise. I strongly advised against any such effort and offered to stand by with a gun if one could be produced. While this discussion was in progress the animal moved slightly and the crowd stampeded backwards in such a hurry that it was with the greatest difficulty that we remained on our feet. The animal settled again in the same place. There was further discussion and as light was fading I thought I had enough of this adventure and turned homewards after warning the Ranger against any attempt to "catch" the panther.

The next day we learnt that the animal had died and that it had been sent to the Bombay Veterinary College for a postmortem.

I was unable to get reliable information regarding the manner of its death but I requested Mr. P. W. Soman, a member of the Society, who lives at Bhiwandi, to visit the place and get such information as he could. It would appear that a farmer Namdeo Jadhao in an adjoining village had encountered the animal on the previous day and been bitten and scratched in several places. His shouts brought help but Namdeo fell unconscious and was removed to hospital. On the next day the animal injured two more persons but was obviously very ill and finally took refuge in the aforesaid hut.

Though I have no definite information as to whether the animal was actually wrapped up in a blanket and put into the cage or had passed out before this was done, it was indeed a most curious happening.

The postmortem report follows.

HUMAYUN ABDULALI

75, Abdul Rehman Street,
Bombay-400 003,
February 23, 1982.

3. NOTE ON THE AUTOPSY AND CAUSES OF DEATH OF A PANTHER

The carcass was in an emaciated and putrified condition.

Throughout its length the intestine showed numerous pea-sized fibrous nodules visible through the outer surface of the intestine. Each nodule communicated with the lumen of the intestine by 2 or 3 openings and contained one to three nematode parasites 10-15 mm. long. The cavity of the nodule and also the intestine of the living worm were full of blood, They have been identified as *Galunchus* sp. of the "Hook worm" family which worms are well known as voracious blood suckers. Baylis and Daubney recorded a single specimen from a leopard in Calcutta in 1922. The present finding is the first occasion when such large numbers are found in a single panther in India.

The eggs of these worms pass through the fæces of the panthers and develop into infective stages in moist localities. The carnivora generally acquire the infection by the entry of the worms in their soil-stages through their foot pads in moist localities.

The presence of numerous fibrinous nodules in a large portion of the intestine rendered it incapable of absorbing the digested food which resulted in emaciation and loss of vitality. The loss of blood led to anaemia and finally death.

In addition, the lungs revealed two hard nodules of the size of a groundnut. After careful dissection it was observed that each nodule contained a pair of flukes identified as *Paragonimus westermanii* (Lung flukes). They were 8-12 mm. long, 4-6 mm. broad and 3-5 mm. thick. This parasite was first discovered by Westerman in 1877 from the lungs of two tigers which died in the Amsterdam Zoo. Man is an important definitive host of this fluke as are other carnivorous animals. The panther may have acquired the flukes by eating crabs or cray fish containing the early stages of the flukes or by drinking water containing the larval stages detached from dead crabs. Schaller 1967, in 'The Deer and the Tiger', page 236, refers to these matters and adds that though in his experience no crab remains were found in the fæces, Burton (1936) and Perry (1964) listed crabs as being part of the tiger's diet.

BOMBAY VETERINARY COLLEGE,
PAREL,
BOMBAY-400 012,
February 23, 1982.

S. M. NIPHADKAR
V. S. NARSAPUR
V. S. DESHPANDE

4. TRANSPORTATION OF YOUNG BY RATEL (*MELLIVORA CAPENSIS*)

While going through my old field notes I came across an entry which may be of interest to the readers of the *Journal.*

In Sagar district of Madhya Pradesh in 1963 we saw a ratel (*Mellivora capensis*) running on the road in front of the vehicle on a winter evening. A hunter shot the animal, which turned out to be a female. On going upto it we found that a male cub which was unscathed, had fallen off its mother's back.

I kept the cub for a couple of weeks and it was doing quite well on a mixture of minced meat and milk, laced with vitamins. It had already been weaned. The body emanated a very strong, musky and pungent unpleasant scent which was not related to food or upkeep, as it was always given fresh food and kept clean. Whilst away on tour the carelessness on the part of my servant allowed it to contract disease and it died 3 days later. Autopsy revealed it to be Pneumonia.

Carrying of juveniles and young on the back is a well recorded fact among the bear family (Ursidae) to which, of course, the ratel is related. But this behaviour does not appear to have been yet recorded in the ratel of which, in fact, so little is known.

THE PALACE,
WANKANER,
GUJARAT,
May 10, 1982.

M. K. RANJITSINH

5. BURROWING PATTERNS OF SAND-COLOURED RAT, *RATTUS GLEADOWI*

(*With a text-figure*)

The Sand coloured rat, *Rattus gleadowi* (Murray, 1885) has a localised distribution in the Indian desert. A highly specialised species, it is nearer the genus *Acomys* and possesses characteristics of Gerbillinae (second palatal foramina and hypertrophied bullae tympanicae). In western Rajasthan, it occurs in very low numbers, 0.6 per cent of total rodent fauna and prefers sandy (66.6%) and gravel (33.3%) habitats in the desert biome (Prakash *et al.* 1971). Their burrows are found scattered in open sandy or gravel plains, but are also seen under the thickets of *Zizyphus nummularia.* In Sind, this rat has been reported to live near the roots of salt wort plant (Chenopodiaceae) (Roberts 1980).

The rat does not excavate very large and extensive burrow systems (Figure 1) as found in case of the predominant rodent species of the desert, *Meriones hurrianae* (Fitzwater & Prakash 1969). Most of the burrows are simple and short and it appears that such burrows are excavated for temporary shelter, feeding or escaping from predators. The burrow openings are of 3.5 x 5 x 5 x 4 cm dimension. About 50% burrows are 'L' shaped, 30% 'V' and 'D' shaped, 10% long tunnels, 8% burrows small tunnels with a blind end and only 2% are complete burrows. A complete burrow system possesses 4 to 6 external openings in addition to a plugged one, possibly for emergency escape. Burrow depth ranged from 9 to 21 cms. The largest burrow length recorded was 130 cms (range 7 cms to 130 cms) which is quite long as compared to the records from west Sind (45-61 cms; Roberts, loc. cit.). Perhaps, the burrow systems in Pakistan were excavated in the non-breeding season, while in present report these were dug at the end of breeding season (in November) August to October (Prakash 1971).

In some burrows, gryllids and carabid beetles were found to inhabit the burrows as associates. Seeds of *Cenchrus biflorus, C. ciliaris, C. setigerus* and *Tribulus terrestris* were found in nest chambers, indicating that this species may be damaging the rangeland in the Indian desert.

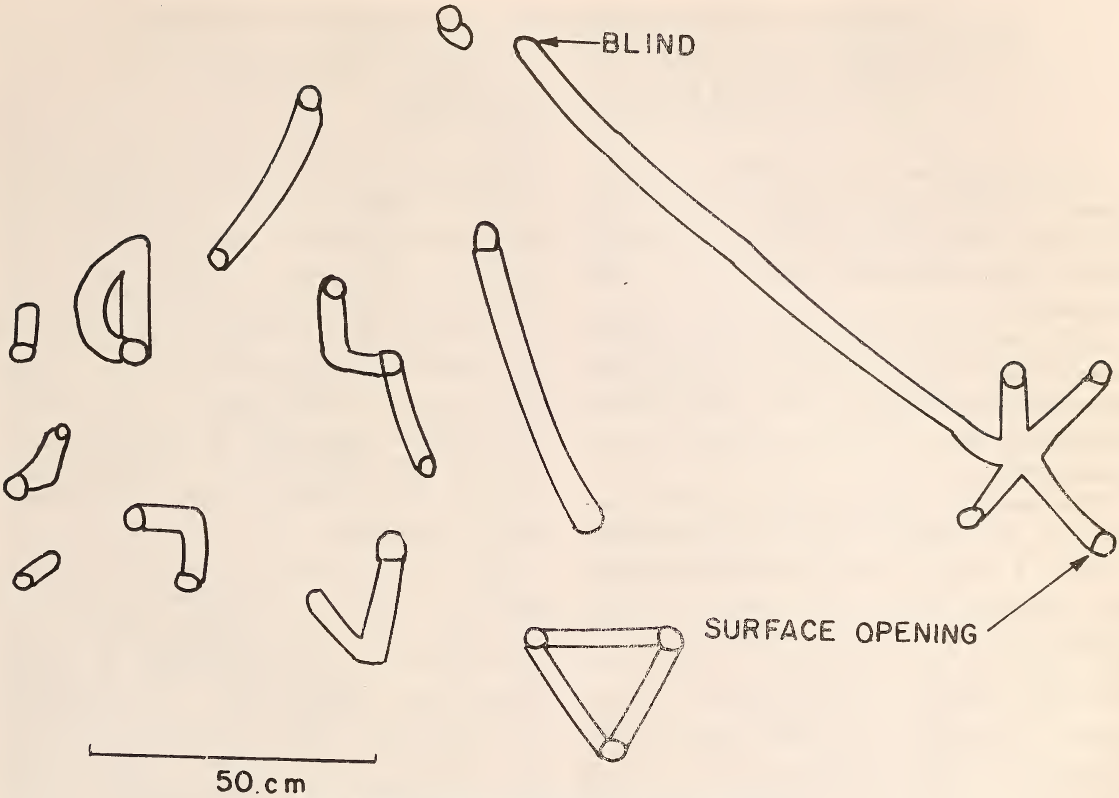


Fig. 1. Burrowing patterns of *Rattus gleadowi*.

ACKNOWLEDGEMENTS

Thanks are due to Dr. H. S. Mann, Director, C.A.Z.R.I., Jodhpur for providing facilities and to Dr. Ishwar Prakash, Professor of Eminence at the same Institute for his kind guidance and critical editing of the note.

RANJAN ADVANI
A. P. JAIN

COORDINATING & MONITORING CENTRE
FOR RODENT AND TRAINING,
CENTRAL ARID ZONE RESEARCH
INSTITUTE, JODHPUR-342 003,
January 18, 1982.

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6. AN INSTANCE OF INTERSPECIFIC AGGRESSION BETWEEN CHITAL (*AXIS AXIS* ERXLEBEN) AND BLACKBUCK (*ANTILOPE CERVICAPRA* LINNAEUS) AT POINT CALIMERE SANCTUARY, TAMIL NADU

At 8.35 hrs on 5th May 1982, I had the chance of observing an aggressive interaction between a male Chital (*Axis axis* Erxleben) and a male Blackbuck (*Antilope cervicapra* Linnaeus).

Intraspecific fights and interspecific encounters in the form of chasing each other have been noticed in ungulates, but actual physical encounters has not been reported between these species.

The area where this encounter occurred was towards the southern part of the Sanctuary close to a wedge of scrub jungle, opening out into grassland. Both animals appeared highly agitated and it was not possible to identify the aggressor. Each would back 2-3 steps and then leap forward to clash head-on. The contestants appeared to be equally matched. The forehead was the most affected body part in the bout for both the animals. The horns were thrust forcefully when they tried to push back each other during the bout. The spikes of the stag's antlers seemed to be advantageous as they could reach the soft portions of the body other than the forehead of the enemy. At least twice the Buck tried to twist sideways and jab the side of the stag, with its pointed horns, but the Chital defended itself successfully. It was impossible to assess as to who was winning. Twice the Buck managed to push the stag a few steps back and once he himself was pushed back. I observed the duel for 2½ minutes when they dispersed on seeing me. The Chital ran into the nearby jungle and also the Buck which ran for about 15 metres and disappeared into the same forest patch. No other animal of either species was seen in the vicinity.

Some notes on the status of the two species at Point Calimere may be of interest. The preferred food plants of the Blackbuck in this area are *Alleuropus* sp. and *Cyperus* sp. which grow extensively in the meadows, their usual habitat. But in May all the grasses in the meadows, dry-up and the green patches occur only at certain places. This situation is apparently aggravated by the high population of the Blackbuck. All wildlife have to compete with a large number of domestic stock for grazing.

The Chital in this dry evergreen forest is chiefly a browser and prefers the jungle to the grassy open areas, unlike Chital in the dry deciduous forest as described by Sharatchandra and Gadgil (1975) from Bandipur. The Chital also faces a shortage of food in this sanctuary in the month of May since the leaf production is at a minimum in this month (Avifauna Project Report—I, 1981).

The threat to the Blackbuck population in this sanctuary is mainly due to their dynamically increasing population. Daniel (1967) suggested the possibility of the population exceeding the carrying capacity of the sanctuary in 1967 itself when the population was 750. The Forest College, Coimbatore team censused the population at 2,100 in July 1982. According to this latest census it has registered an increase of 280% within a period of 15 years. Nair (1974) had recorded a decline of the population to 340 in 1974, the reason for which he attributed mainly to poaching. There is apparently a certain amount of confusion in census methods. The increased number of fawns however suggests a high rate of breeding success.

If the current census figures are accepted there is apparently a cause for considerable concern. The individual share of the available grazing land has been reduced to 0.5 hectares. They have to share it with a variety of ungulates. For the survival of viable population they need more area than the total of the individual shares. This sanctuary is susceptible to seasonal variations and the Blackbuck faces food shortage in the dry season as described above and the condition in the rainy season deteriorates further as during this season they are deprived of most of their feeding grounds as these areas are filled with brackish water. They are then compelled to take shelter in the unflooded patches and the jungle, where food is scarce for them and the seashore, where the vegetation comprises mainly of the succulent plants, *Salicornia brachiata* Roxb. and *Suaeda maritima* Dumort, the preference of Blackbuck towards these is the least. Naturally this situation drastically changes their biological and behavioural activities. Such a large population will find it difficult to survive in this circumscribed ecological regime with extremely limited food and space for movement. This may lead to a steep decline in the population and bring down the genetic quality of the stock, if not their total disappearance from this sanctuary. Proper management techniques should be applied so that the biotic, edaphic and climatic factors of this ecosystem can remain in dynamic equilibrium, with respect to the Blackbuck. Introduction of this unique endemic antelope of the Indian plains, from this sanctuary to other similar habitats also can be tried.

S. FAIZI

AVIFAUNA PROJECT,
POINT CALIMERE SANCTUARY,
KODIKKARAI,
THANJAVUR DISTRICT,
TAMIL NADU,
August 10, 1982.

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SHARATCHANDRA, H. C. & GADGIL, MADHAV (1975): A year of Bandipur. *J. Bombay nat. Hist. Soc. 72* (3): 623-647.

7. A SIGHTING OF A LARGE DHOLE PACK IN KANYAKUMARI DISTRICT, TAMILNADU

In the first week of April, 1982 while going in a jeep through coupe VIII of a rubber plantation in Keeriparai Division, Kanyakumari District a pack of dholes (*Cuon alpinus*) was seen. The time was around 1600 hrs. and I counted 28 dholes before the pack entered the adjoining tropical moist deciduous forests with dense undergrowth. The pack had some pups and as the distance between the leading and the last dhole was around

200 m. I could not exactly differentiate the pups from the adults.

The forests of this division still have sambar (*Cervus unicolor*), wild pigs (*Sus scrofa*) and mouse-deer (*Tragulus meminna*). In addition, numerous domestic cattle graze in these forests. Earlier, while working in Kalakad Wildlife Sanctuary as Wild Life Warden in 1977, I have seen 26 dholes. Johnsingh (per. comm.) reports that the maximum number of dholes, he saw in Bandipur was 18, and he attributes this to the size of the common prey. Chital (*Axis axis*) which is one third of the size of the sambar. If prey size determine pack size, the larger packs seen in Kalakad and Keeriparai could be attributed to the common prey, the sambar.

DEPUTY CONSERVATOR OF FORESTS
(HEAD QUARTERS),
OFFICE OF THE CHIEF CONSERVATOR OF
FORESTS, MADRAS - 600 006,
August 4, 1982.

S. RAMANATHAN

8. PINKFOOTED SHEARWATER [*PROCELLARIA CARNEIPES* (GOULD)] IN INDIA

On 19th May 1979, one of us (R.B.G.) was at Kanyakumari at the southernmost tip of India, when he saw some fisher boys on the shore offering for sale six petrels which they had caught on fish-hooks a few miles out at sea. Two of these were purchased, skinned and added to the Society's collection, but though correctly identified as the Pinkfooted Shearwater [*Procellaria carneipes* (Gould)] the record was inadvertantly not published at the time.

INDIAN HANDBOOK (1, p. 11) refers to two examples taken in Ceylon, one in 1879 and the other in 1945 as the only records from our area. Subsequent to this, small numbers were observed by W.W.A. Phillips in Equatorial Channel in the southernmost Maldives in early July (*JBNHS* 55, p. 216) and Strickland and Jenner (*JBNHS* 74, p. 490) in Birds of Addu Atoll (southernmost portion of the Maldives, south of the Equator) say "Probably mainly a passage migrant. Noted March — May 1958 and 16th-20th October 1975, but hundreds of birds passed close inshore".

Bourne (1960) in *Sea Swallow* (13 p. 26) Petrels of the Indian Ocean says "northward movement starts during May and birds are seen flying northwest reaching the vicinity of Java, Ceylon, and south coast of Arabia by mid-summer — concentrate off Arabian coast in late summer and return in September, when numbers have been seen off Cochin".

There is also a sight record at 08°16′N, 69°15′E on 4th August — A. S. Cheke, *Ibis* 1969, p. 628.

There are really few records from Indian limits and the two specimens referred to above apart from adding a new species to the Bombay collection may be worth publishing. They are both males and their wings are 308 and 322 mm., (*vs.* 299 to 316 in Ind. Hb. reproduced from Stuart Baker's *Fauna* 6:305) bill 42-42.5 (41-46), tarsus 42, 42 (about 52 to 56) and tails 101, 107 (137 to 148). The tails, it will be noticed, are appreciably shorter than recorded.

75 Abdul Rehman Street,
Bombay-400 003.

HUMAYUN ABDULALI

Bombay Natural History Society,
Hornbill House,
Shahid Bhagat Singh Road,
Bombay-400 023,

ROBERT GRUBH

July 18, 1981.

After completion of the above H.A. saw a note in the Bulletin of the British Ornithologists Union (1980) 100 p. 205 where P. R. Colston, British Museum (N. H.) wrote of a sea-trip from Australia when "the first Pale-footed Shearwaters (*P. carneipes*) were sighted in rough seas on 16 July near Bombay." In reply to an inquiry Mr. Colston says "The ship arrived and left Bombay on 15 July 1963 and it was on the following day 16 July that I saw *c*. 20 Pale-footed Shearwaters. I would guess some 500 miles west of Bombay — en route for Aden. So they were not close enough for your Bombay list". This may be mentioned for completion of records in Indian literature.

May 5, 1982.

9. THE PINTAIL (*ANAS ACUTA* LINN.) — AN ADDITION TO THE LIST OF BIRDS OCCURRING IN KERALA

A small artificial lake brought into being around 1968 for the supply of fresh water to the Cochin Unit of the Fertilizers and Chemicals Travancore Ltd., at Ambalamedu began to be used as a daytime refuge by wintering wildfowl soon after its creation. On my first visit to this excellent refuge (7 to 9 February, 1981). I was surprised to find that in addition to the Garganey (*Anas querquedula*) and the Lesser Whistling Teal (*Dendrocygna javanica*) there were not less than 3000 Pintail (*Anas acuta*) on the lake. As nearly 50% of the Pintail were males in summer plumage, there was absolutely no doubt regarding their identity. I was able to watch the Pintail and the other ducks many times during the three days I spent at Ambalamedu.

On 7 March, 1981, I was able to spend a few hours beside the Ambalamedu lake once again. On this occasion too all the three species noted a month ago were present, but the number of Pintail was below hundred. On the previous day, when camping at Kumarakam near Kottayam, from the number of ducks seen overhead in the evening, I concluded that the well-known roosting site off Pathiramanal in the Vembanad backwaters (Sálim Ali 1969) continues to be used by large numbers of ducks. Here, however, the ducks are being persecuted regularly by hunters, whereas at Ambalamedu they are given good protection. Unfortunately, the Ambalamedu lake is too small for all the ducks to resort to it during the daytime. Therefore, and especially since this area is being developed into a tourist centre with the accent on boating and water-sports, immediate steps have to be taken to provide complete protection to the wildfowl that spend the daytime on the water off Pathiramanal. This is the only major waterfowl resort left in Kerala today.

Considering the fact that the Pintail is one of the easiest of wild ducks to identify, it is surprising that no previous record of its occurrence in Kerala seems to exist. Could the drought of 1980-81 on the eastern side of the

Peninsula have forced the Pintail to move west?

The Cochin Unit of FACT deserves the gratitude of all bird lovers and conservationists for the commendable manner in which they are managing the environment generally, and the lake in particular, in order to provide the maximum security to their birds, both resident and migrant. I am personally obliged to Mr Vijaya Sankar, Managing Director, Mr T. Nandakumar and Mr Padmanabhan, Officers, of the FACT Cochin Unit, for their hospitality and help.

26/1643 Unni's Lane,
Trivandrum,
July 6, 1981.

K. K. NEELAKANTAN

Reference

Ali, Salim (1969): Birds of Kerala. Oxford University Press, Madras, p. 41.

10. FLAMINGOS BREEDING IN THOL LAKE SANCTUARY NEAR AHMEDABAD

On 21 June 1981, I visited the Thol Lake Sanctuary about 30 km from Ahmedabad along with a party from Doordarshan for making a film programme on Flamingos.

The flamingos were approximately 5000-6000 in number, and other water birds were also seen in large number. The most surprising sight was the presence 70-80 of Flamingo nests. Young ones of the Flamingo were also noticed. As the birds had remained throughout the whole year (May 80-May 81) in this area, I wondered whether the birds had bred also, and this had lead me to search for their nests. Finally we were successful in locating the nest colony. The nests were 70-80 and in small groups of 5-6 at different places, on the opposite bank of the lake .

The possibility of this area being an additional breeding ground for Flamingos in India, apart from already known breeding ground in Great Rann of Kutch, needs to be placed on record.

17, Swarajnagar,
Ambawadi, Ellisbridge,
Ahmedabad - 380 015,
June 27, 1981.

P. S. THAKKER

11 OCCURRENCE OF CERTAIN WADERS IN SRI LANKA

Recently I had occasion to leaf through Volume 2 of the 2nd Edition of the HANDBOOK and a few comments in regard to the occurrence of certain Waders in Sri Lanka seem necessary.

No. 374. Large Sand Plover (*Charadrius leschenaultii*) — Although the distribution map shows Sri Lanka as a wintering place for this species, Sri Lanka is not mentioned in the text. The Large Sand Plover is reported fairly often (see Bird Club Notes).

No. 378. Eastern Ringed Plover — (*Cha-*

radrius hiaticula tundrae) — There have recently been several authentic sight records of this species, all recorded in the Bird Club Notes, by Dr T.S.U. de Zylva, myself and one or two others. There can be no doubt about these. 1979 seems to have been a particularly good year for relatively rare Waders.

No. 389. Blacktailed Godwit (*Limosa limosa limosa*) — "... becoming very rare in South India and Ceylon". This has changed during recent years and these birds now come to Sri Lanka by the hundreds every winter. I myself have seen large congregations in northern lagoons prior to the return migration. These observations have been frequently reported in the Bird Club Notes; also in my annual Notes from the Ceylon Bird Club, published in the June issue of 'Loris' each year.

No. 392. Spotted Redshank (*Tringa erythropus*) — This bird too is now regularly seen. There are at least one or two reports every year. I think its "rarity" is chiefly due to the difficulty of distinguishing it from the Common Redshank. I saw one in unmistakable breeding plumage on the east coast on the 16th of April, 1976 (see Bird Club Notes, April 1976, page 18). I then wrote that during that winter I had seen nearly a dozen Spotted Redshanks.

No. 395. Marsh Sandpiper (*Tringa stagnatilis*) — Very large congregations of this Sandpiper have been seen in the salterns of Hambantota.

No. 400. Terek Sandpiper (*Tringa terek*) — This species is not only found on the north-west coast, but all along the coasts, especially also the north-east coast.

No. 413. Eastern Knot (*Calidris tenuirostris*) — 4 birds of this species were recently seen near Mannar by Ben King and party (see Notes for May 1981).

No. 420. Dunlin (*Calidris alpina alpina*) — Several Dunlins have been seen in Sri Lanka in recent years by myself and other observers. One was an authentic sighting by me of a bird moulting into breeding plumage at the edge of a lagoon in Yala East on the 10th of April, 1979, (see Bird Club Notes 1979, page 20).

T. W. HOFFMANN

CEYLON BIRD CLUB,
C/O. P. O. BOX 11,
COLOMBO,
SRI LANKA,
June 10, 1981.

12. THE CHESTNUT-HEADED BEE-EATER (*MEROPS LESCHENAULTI* VIEILLOT) IN GUJARAT

While accompanying Shri R. Naoroji on an expedition to photograph birds in the Chandod and Rajpipla areas of Gujarat State I sighted a pair of what seemed to be Chestnut-headed Bee-eaters while walking towards Poecha village across the Narmada from Chandod which is about 22°N and 73.5°E. The pair was seen first flying around some bushes and then alighting on a large rock about 35 feet from me. Looking through 8 x 30 binoculars I clearly noticed the chestnut head (colour reminiscent of crow-pheasant wings) and bright yellow throat under which was a dark and pale chestnut band. Both birds did not have the central tail feathers prolonged and the birds were slightly bigger than the Common Green Bee-eaters but slightly smaller than the Blue-tailed Bee-eaters, a colony of which had nesting holes on a vertical sand bank. After watching them for sometime, the pair flew southwards towards Rajpipla. When I returned to Bombay, though I had with me Sálim Ali's invaluable BOOK OF INDIAN BIRDS, for reference I checked up my notes in with the specimens and also the HANDBOOK of Indian Birds Vol. 4, Ali-Ripley at the BNHS and was convinced that the pair was that of the Chestnut-headed Bee-eaters. Since these birds are not recorded north of Goa or Belgaum, it might be the northernmost record for the species in Western India. The birds were recorded on 5th June, 1981 in the morning. These birds do have sudden local migrations as stated in the HANDBOOK. The birds seen appear to be migrating and were not found in regular forest but amongst scattered trees and shrubs not far from the Narmada river.

S. G. MONGA

45/46, MADHURIMA,
M. G. ROAD,
KANDIVLI (WEST),
BOMBAY - 400 067,
August 17, 1981.

13. SUNBIRDS FOSTERING FLEDGLINGS OF THE PLAINTIVE CUCKOOS

On two occasions I have seen sunbirds being used by the Plaintive Cuckoo as foster parents for its young. Both incidents were observed in my garden in Pune. The first time I saw this was during the 1960s when I saw a pair of Purple Sunbirds (*Nectarinia asiatica*) bring up a fledgling cuckoo.

More recently, in 1978, I have photographed the Purplerumped Sunbird (*Nectarinia zeylanica*) rearing the young of the Plaintive Cuckoo.

The nest was in a Jambul tree in my garden at Bund Garden Road. For several days I had seen a rather large head poping out of the nest for feeds. Shortly thereafter there was a storm, the nest broke open and I saw the cuckoo fledgling, clumsily fluttering around, and noisily following its little foster parents. It had dark brown bars over its back and wings and a lighter streaked buff belly. There was a pale patch on his wing better seen in flight. I observed them for more than a week by which time he had grown considerably larger. The foster parent's head would be engulfed in his gaping mouth during each energetic feed.

Looking for references I have come across one published by M. F. Suter (JBNHS, 45: 235). He had seen a cuckoo chick fostered by purple sunbirds and being also fed in turn by Tailor birds in Pune in 1944. I believe another similar observation has also been made in Pune in the 1980s.

I have thus come across four instances of such parasitism all from Pune, the earliest in 1944. This might indicate a local change in the pattern of parasitism?

A female cuckoo is believed to use the same host for parasiting as she herself was reared by. Thus if early imprinting results in the female cuckoo selecting nests similar to the one she was born in, these birds which have been reared by sunbirds will look for sunbird nests to lay their own eggs when they become adults. The new pattern should then become more common. Further observation especially in Pune may throw more light on the problem.

23/5, Bund Garden Road,
Pune - 411 001,
August 24, 1981.

ERACH K. BHARUCHA

14. MAGPIE-ROBIN FEEDING ON GECKOES

Recently, I have observed for several evenings in succession, an adult female Magpie-Robin, late in the evenings, swooping on to medium-sized (about 3 inches in total length) *Hemidactylus leschenaulti,* on the outer walls of our bungalow in the scrub-jungle. At every swoop from its hovering in the air, the robin pecks at the pelvic region of the gecko, perhaps to disable the gecko, and when it falls to the ground ultimately, the bird pecks off the contents of the abdomen first, and then eats away the rest of the body, tearing it piecemeal. Just one gecko a day, but the same female Magpie-Robin everyday, at the same time, from among the nearly 3 to 4 pairs of these robins permanently residing and nesting in the ceiling of our bungalow.

5, College Estate,
Madras Christian College,
Tambaram, Madras 600 059,
August 21, 1979.

STEPHEN SUMITHRAN

15. OCCURRENCE OF FOREST WAGTAIL (*MOTACILLA INDICA* GMELIN) IN NAGZIRA SANCTUARY, BHANDARA DISTRICT (MAHARASHTRA)

On 24th April 1981 during the carnivore survey of Nagzira, I spotted a wagtail which appeared to be a Forest Wagtail (*M. indica*) on the edge of a tank. The white wing bars, the necklaces and the habit of swaying its tail sideways made this bird quite unmistakable. I watched it for about 10 to 15 minutes until it took flight and disappeared into the woods. I searched for it thereafter but never saw it again.

This is apparently the first record for this part of the Peninsula.

27A/1, Civil Lines
Nagpur,
August 18, 1981.

NITIN JAMDAR

[The Forest Wagtail has a very capricious winter distribution in the Subcontinent and may sporadically occur as a vagrant almost anywhere, even in the most unlikely localities and habitats. One has been recorded from Thatta district of Pakistan! (JBNHS 75: 218. 1976) — Eds.]

16. BIRDS IN 650-1100 MM RAINFALL ZONE OF RAJASTHAN

During faunistic surveys conducted by the Desert Regional Station, Zoological Survey of India, Jodhpur in November-December 1975, thirteen species of birds spread over nine families were collected from districts of Boondi, Tonk, Jhalawar, Dungarpur and Banswara in south Rajasthan. This region receives annual rainfall ranging from 650 mm to 1100 mm (avg. 850 mm). The relative humidity is 52 percent with 35 rainy days. The forest is of dry teak type with vegetation dominated by species of the genera *Cardamine, Crotalaria, Cyperus, Ipomoea, Planera* and *Lindernia.* Three rivers Mahi near Banswara and Dungarpur, Kali Sindh near Jhalawar and Banas near Tonk attract several species of migratory birds.

The birds observed and collected during the survey under the respective families were:

Ardeidae: Cattle Egret, *Bubulcus ibis coromandus,* Indian Pond Heron, *Ardeola g. grayii*; Charadriidae: Red Wattled Lapwing, *Vanellus i. indicus,* Ruff, *Philomachus pugnax*; Apodidae: Indian House Swift, *Apus a. affinis*; Meropidae: Green Bee-eater, *Merops orientalis*; Upupidae: Hoopoe, *Upupa epops*; Laniidae. Bay-backed Shrike, *Lanius vittatus*; Pycnonotidae: Red-vented Bulbul, *Pycnonotus cafer humayuni;* Muscicapidae: Indian Robin, *Saxicoloides fulicata cambaiensis,* Jungle Babbler, *Turdoides striatus sindianus,* Black Redstart, *Phoenicurus ochruros rufiventris*; Ploceidae: House sparrow, *Passer domesticus.*

Observations on the spot and examination of crop and gizzard contents showed that species like, *P. domesticus, T. striatus, P. ochruros* and *P. cafer* were serious pests of agricultural and fruit crops like millet, barley, rice, guava and grapes. Whereas, some species viz., *L. vittatus, S. fulicata, U. epops, M. orientalis, A. affinis, B. ibis* and *A. grayii* were thriving upon various polyphagous insect pest of crops like grasshoppers (*Hieroglyphus* sp., *Oxya* sp., *Chrotogonus* sp.), termites (*Anacanthotermes* sp., *Microtermes obesii, Odontotermes obessus*), white grubs (*Holotrichia insularis*), and cutworms (*Agrotis* spp., *Spodoptera* sp.). Thus, these are considered to be beneficial to agriculture in minimising populations of these harmful insects in the crop ecosystem.

Thanks are due to Dr. A. K. Mukherjee, Supt. Zoologist, Zoological Survey of India, Calcutta for confirming identification of birds.

RANJAN ADVANI

CENTRAL ARID ZONE RESEARCH INSTITUTE,
JODHPUR (RAJASTHAN), INDIA,
August 31, 1981.

17. DISPERSAL OF SANDALWOOD (*SANTALUM ALBUM*) BY BIRDS IN TAMILNADU[1]

INTRODUCTION

This paper has no pretensions and is not an outcome and product of any purposive research. I have been watching birds just for the pleasure it gives one and had been taking notes among other things, on their feeding habits. The period of fieldwork for the Forest Resources Survey of Ramnad and Tiruchirapalli Districts, and service as warden of the Mundanthurai and Kalakad Sanctuaries in Tirunelveli District provided opportunities to work in sandalwood areas and for observing the birds feeding on sandalwood fruits. This article is based on those notes.

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[1] Paper presented at the Second All India Sandal Seminar, Salem — May 1981.

Materials and methods

Avian fauna was checklisted during the field work for preparation of Forest Resources Survey Reports of Ramanathapuram and Tiruchirapalli Districts and for Kalakad and Mundanthurai Sanctuaries. The sandal bearing areas Srivilliputhur R. F., Pachamalai, Mundanthurai plateau and Valliyur R. F. have rich and variegated bird life. Ingestion of sandalwood fruits by birds was not systematically noted, Quantification of parameters like feeding rate, dispersal distances, and areas of spread relevant to the quest were not thought of. Only materials collected sporadically are described. The birds found eating sandalwood fruits are listed below in the sequence of Ripley (1961).

Among the birds listed here, bulbuls, mynas, greenbilled malkoha, koels and fruit pigeons appear to consume large quantities of fruits (more than 10 observations). Redvented bulbul appears solely responsible for spreading of sandalwood upto distances of 3-4 Km. in Vaigai Dam. Blackheaded bulbul consumes large quantities of these fruits in foothill and hill forests. Common myna and Brahminy myna

ORDER	FAMILY	SPECIES
COLUMBIFORMES	Columbidae:	1. *Treron phoenicoptera* Green pigeon
		2. *Ducula badia* Imperial pigeon
		3. *Columba livia* Blue Rock pigeon
		4. *Streptopelia chinensis* Spotted dove.
PSITTACIFORMES	Psittacidae:	5. *Psittacula krameri* Roseringed parakeet
Cuculiformes	Cuculidae:	6. *Clamator jacobinus* Pied crested cuckoo
		7. *Cuculus varius* Common hawk-cuckoo
		8. *Eudynamys scolopacea* Koel
		9. *Rhopodytes viridirostris* Small greenbilled malkoha
CORACIFORMES	Bucerotidae	10. *Tockus birostris* Common grey hornbill
		11. *Buceros bicornis* Great Indian hornbill
PICIFORMES	Capitonidae	12. *Megalaima viridis* Small green barbet
PASSERIFORMES	Pittidae	13. *Pitta brachyura.* Indian pitta.
	Oriolidae	14. *Oriolus oriolus* Golden oriole
	Sturnidae	15. *Sturnus pagodarum* Brahminy myna
		16. *Acridotheres tristis* Common myna
	Corvidae	17. *Dendrocitta vagabunda* Tree pie
		18. *Corvus splendens* House crow
		19. *Corvus macrohynchus* Jungle Crow
	Irenidae	20. *Chloropsis aurifrons* Goldfronted chloropsis
	Pycnonotidae	21. *Pycononotus atriceps* Blackheaded bulbul
		22. *Pycnonotus jocosus* Redwhiskered bulbul
		23. *P. cafer* Redvented bulbul

consume considerable quantities of these fruits. As these birds are gregarious and cover long distances in their diurnal movements, they may make efficient dispersers. The Evergreen Forest dwellers — Green pigeon, Imperial pigeon, Great Indian hornbill come to lower elevations from 1000 m to 200 m as in Mundanthurai in small parties of 5-7 during the fruiting season and consume large quantities of fruits. Green pigeon and Imperial pigeon were seen only in the mornings, throughout the fruiting season. Great Indian hornbills spend longer duration 3-5 hours consuming these fruits on even short trees 5 m tall. Koels again, in large noisy parties spend many (3-6) hours consuming these fruits throughout the fruiting season in almost all areas. On Mundanthurai plateau, small greenbilled malkohas were seen consuming the fruits throughout the day all through the fruiting season. Even a small bird like Indian Pitta consumes the fruit with surprising ease. Roseringed parakeets generally damage the seeds and eat cotyledons. Other birds were seen only for less than 10 observations.

The habitat types in these districts where the birds were seen are listed below. The Forest types are based on Working Plans of the relevent areas (Johnson 1976, 1977a, b).

1A	C4	West Coast Tropical Evergreen Forest.
2A	C2	West Coast Semi-Evergreen Forest.
2A	C3	Tirunelveli Semi-Evergreen Forest.
5A	C1(b)	Dry Teak Forest
5A	C3	Dry Mixed Deciduous Forest.
5	DS 2	Dry Savannah Forest
5A	DS a	Southern Tropical Dry Deciduous Scrub.
6A	C1	Southern Thorn Forests
6A	C2	Carnatic Umbrella Thorn Forest
6A	DS 1	Southern Thorn Scrub.
7	C1	Tropical Dry Evergreen Forest.
8A	C1	Southern Sub-tropical Hill Forest.

In most of our forest types and in large areas bird life is abundant and all frugivorous birds have the potential for dispersing the sandalwood. Distribution of suitable perches, abundance of fruit bearing trees in all seasons and availability of insect food during breeding season generally govern the distribution of the birds. The location of mature sandal trees and their natural dispersal appear to be significant. Natural propagation is effective in the openings between two forest types and in clearings fringing two or more habitat types as in Valliyur R.F.

There is a forested island in the Lower Dam reservoir in Mundanthurai Sanctuary, where a good number of sandalwood trees (about 300) aged about 25-30 years occur. These areas were clearfelled in the early forties and only birds, koels, bulbuls and malkohas, have been responsible for the propagation of the sandal here. Lantana was probably the first to invade the island. Attracted by lantana berries, available in plenty throughout the year, birds visited the island and disseminated sandal seeds from the mainland.

Fruiting season

Authorities have recorded differently the season of flowering and fruiting of sandal. Brandis (1906) flowering February-July; Troupe (1921) flowering February-April, fruiting May-June; (Dickinson) Flowering at the end of hot weather or early in the rains and ripening in a few months usually by the close of rains, (Hutchins) Venkataramanan (1957) flowering May-June and February-March, fruiting October-December and July-August; Bourdillon (1980) flowering and fruiting all the year round; In Vaigai Dam Forestry Training School there were seven trees close to the Principal's room, three to six years old, which were being watered daily and were in flower and fruits all through the year, different trees flowering at different times. In other parts of the School Campus, the flowering and fruiting of sandalwood trees had direct dependance on the first heavy showers. On Mundanthurai plateau, flowering and fruiting were observed throughout the year — flowering first ten to fifteen days after the first heavy showers. Older trees flowered later, while planted young trees flowered earlier. The birds do not feed exclusively on any one fruit, though abundant and available in nearby localities. The occurrence of a variety of fruit trees helps in keeping the birds in a particular habitat.

CONCLUSION

Dispersal of seeds by birds, obviously appears to be beyond our control and established forestry practices. Production of seeds, dispersal at right places during the right season, germination and establishment are sequence of factors over which we can have no command. However conditions, extant and obviously congenial for the propagation of sandalwood can be maintained. There appears to be no exclusive preference of birds towards sandal fruits. So occurrence of other fruiting trees and shrubs, which may not be of any economic importance may have to be left. Creation of sandalwood patches amid other plantations of longer rotation may enable extensive establishment in due course. Depending on local conditions the distribution pattern of sandalwood trees can be planned, to a limited extent.

I am thankful to Thiru T. Achuya I.F.S., Chief Conservator of Forests for the interest evinced and general encouragement given to me.

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18. REDISCOVERY OF THE FOREST CANE TURTLE, *HEOSEMYS (GEOEMYDA) SILVATICA* (REPTILIA, TESTUDINATA, EMYDIDAE) FROM CHALAKUDY FORESTS IN KERALA

During a recently conducted search for *Heosemys silvatica* (Henderson 1912) a single specimen was found in the Chalakudy forests of Kerala State after a period of 70 years. The forest cane turtle or *choorel amai*, as it is called by tribals was first discovered by Dr. Henderson in 1912 when two male *Heosemys silvatica* were found in the Kavalai area about 1500 ft high in the Chalakudy forests (Smith 1931). A subsequent search for the turtle proved unsuccessful. (Groombridge, in prep.).

Heosemys silvatica is a small, little known turtle, which is entirely terrestrial. All the known specimens have been found at an altitude of above 1000 ft in the rain forests of the Western ghats within Kerala State.

According to the tribals, the cane turtles are not common as the Travancore tortoises *Geochelone travancorica* (Boulenger 1907) which shares the same habitat. The specimen collected was found by using native hunting dogs by the tribals. This small turtle is much relished by them for its flesh.

This terrestrial emydine is herbivorous in diet, reportedly feeding on fallen fruits of 'Ponna' (*Dillenia pentagyna*), *Cordia obliqua*, and fallen jack fruits (*Artocarpus integrifolia*). It does not frequent water, usually concealing itself under reed bamboo groves, fallen logs, rock crevices and similar dark recesses.

In the specimen of *Heosemys silvatica* collected, the head is an attractive red colour — the region around the iris within the eye also being red, the jaw-line is pale yellow, the neck is deep brown, limbs and tail are pale brown. The carapace is orangish, the scutes being slightly imbricate. The plastron is yellow with two irregular brown patches placed on the bridge. The head is large and the upper and lower jaws are deeply hooked. There is a small 2 mm long scaly protruberance on the hind feet which might be sexually diagnostic.

MEASUREMENTS (IN MM) OF *Heosemys* (*Geoemyda*) *silvatica* (Henderson 1912)

	Carapace length	Carapace width	Plastron length	Plastron width	Shell height	Forelobe length	Bridge length	Hindlobe length
Total length:	129.2	93.5	108.0	77.0	45.0	45.5	46.0	38.0
Notch to notch:	127.2	—	118.5	—	—			
Curve:	137.0	117.0	124.0	86.0	—			

In captivity the turtle is generally inactive during the day, while it feeds and moves in the dark. It is suspected to be crepuscular in its activities in nature. It feeds on fruits and greens.

According to one source 2 eggs were found within a female. Eggs are deposited in small cavity on the ground.

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19. BEHAVIOUR OF THE MALE GHARIAL DURING THE NESTING AND POST-HATCHING PERIOD

INTRODUCTION

During the first captive breeding of the gharial in 1980 (Bustard & Maharana 1980) observations were recorded on the behaviour of the male during nesting and incubation and also following hatching of the young. These data provide comparison with observations recorded elsewhere on other species of crocodilians. Del Toro (1969) and Hunt (1969), both reported on parental care in *Caiman crocodilus*. Del Toro stated that the male and female remained near the nest all the time permitting no one to approach. The male took the main defensive role. Both individuals watched the nest and its surroundings even when in the water. The male opened the nest and liberated the hatchlings while the female remained in the water calling to the young. Hunt noted that humans approaching the nest were not attacked. Both male and female occupied an area next to the nest by day and often the male guarded the nest at night. Neither parent opened the nest in response to croaking of the young. Hunt (1975) noted for *Crocodylus moreleti* that the mother crocodile chased other crocodiles except the dominant male away from the hatchlings, and that the dominant male chased all other crocodiles (in this mixed species display) except the two female *moreleti* out of the water but he allowed the hatchlings to bask on his back. Lever (1975) stated that in *C. porosus* the male assisted in nest defence in captivity and Lever and Balson (1978) recorded in *C. novaeguineae* that the male also helped to open the nest at hatching time and also picked up hatchlings in his jaws for transportation from the nest to the water.

MATERIALS AND METHODS

Observations were recorded on the behaviour of a 3.8 m male gharial which had mated with a 3.17 m female gharial housed in an ideal breeding enclosure (Bustard & Maharana, in press), the pool of which measured 59.5 m x 29.7 m x 9.1 m in maximum depth.

RESULTS

1. *At time of trial nesting*:

During the pre-nesting season, when the female emerged during the night to dig trial nests, the male gharial was sometimes observed in the water near the edge of the pool adjacent to the area where the female was digging.

2. *When the female defended her nest* (against humans):

When the research staff approached the nesting sandbank, the female gharial immediately emerged from the water and approached the nest. At such times, if the male noticed this behaviour of the female, he swam to the edge adjacent to the pool where he kept watch.

Shortly before the eggs were due to hatch, the nest was excavated and 15 of the 25 eggs laid were removed for hatchery incubation. In order to prevent disturbance by the female during this operation, the water level in the pool was reduced by 1 m and staff were posted at the adjacent side of the pool to prevent the female emerging. During the entire operation, the female remained at this area, periodically trying to emerge, and the male also came to this edge of the pool. At no time during this operation or during the operation described above, did the male emerge from the water.

3. *At the time of opening the nest*:

The role of the male, if any, at the time of opening the nest by the female is not known as the actual nest opening was not observed.

4. *At the time of post-hatching parental care*:

The male contributed to post-hatching parental care by his periodic presence with the hatchling group. However, he at no time assisted the female in chasing away the other five adult/subadult female members of the group. The mother gharial did not tolerate other members of the group approaching the area of the pool where she remained with the hatchlings.

The hatchlings emerged from the nest on the morning of 7th May 1980. On 12 May 1980 the male was first observed to show an active interest in the hatchlings. The following observations were recorded :

1010 hours :

The male approached the female/hatchling group and came close to the hatchlings some of which were attempting to climb onto the female's back. The female showed no response to the male's close approach, in marked contrast to the behaviour exhibited towards any other members of the gharial group to approach this area of the pool which were chased off. A hatchling climbed onto the base of the male's tail and crawled up to bask on his back. The individual was followed by two further hatchlings, one of which basked on his head and the other on his back. The male cruised slowly towards the middle of the pool with the hatchlings basking on his body and returned to the location of the female and the remaining hatchlings:

Similar observations were observed extending over 15 minutes from 1620 hours.

13th May

At 0600 hours the male approached the female and hatchlings and floated near them. Two hatchlings climbed onto his head and back and three more floated near him in the water.

When the male came to the area of the female and hatchlings at 0700 hours several hatchlings climbed onto his back and head.

At 0745 hours, the male was carrying one hatchling on his back. The other five gharial remained at the opposite end of the pool. The male was observed visiting the female/hatchlings later in the morning and again in the afternoon.

Similar observations were observed on 14 May and again on 15 May when both the mother and the male were providing basking sites for the hatchlings on their heads and backs between 0900 and 1100 hours and again between 1300 and 1700 hours.

17th May

At 1700 when male approached the hatchlings, the mother gharial was lying outside the pool on the sand under the tree. Three hatchlings climbed onto his head and back. He remained with the hatchlings for 10 minutes.

18th May

At 1100 hours the male came to the group and three hatchlings basked on his back. Again at 1400 hours the male floated near the mother and some hatchlings came to the male and climbed onto his head and back. Other hatchlings were basking on the mother's back.

19th May

When the male came to the group at 0900 hours he gathered the hatchlings together by placing his body between them and the edge of the pool and slowly moving them backwards. This action, frequently seen by the female serves to aggregate the hatchlings. This is the only time that the male was observed to do this. He then floated with them for five minutes, with three hatchlings basking on his back, then returned to his favourite basking site in shallow water at the other end of the pool. After a further five minutes he returned to float near the mother and the hatchlings climbed onto his back and remained there for one and a half hours.

At 1600 hours the male again returned to the group and he floated with hatchlings on his head and back.

20th May

At 0900 hours the male came to the group and three hatchlings rode on his back. This was repeated at 1400 hours when two hatchlings rode on his back and head.

Similar observations were recorded during the period 21-30 May but at a lower intensity. Since this was equally true of the mother, it would appear that the constant protection afforded the hatchlings group by the female was waning, and with it the attention of the male.

DISCUSSION

The male gharial played no part in nest-guarding unlike the observations recorded by both del Toro and Hunt for *Caiman crocodylus* and Lever (1975) for *C. porosus*. However, this behaviour agrees with that reported by Whitaker and Whitaker (1977) for the Indian mugger (*Crocodylus palustris*). Nor did the male gharial take part in nest opening, as described by del Toro (1969) for *Caiman crocodylus* and Lever and Balson (1978) for *C. novaeguineae*. However, the male gharial's role with the young is closely paralleled by the descriptions given by Hunt (1975) for *C. moreleti*.

It is noteworthy both that the male gharial showed interest in the hatchling group and that the brood-guarding mother allowed the male to closely approach the hatchlings and carry them on his back, observations paralleled by Hunt (1975) for *Crocodilus moreleti*. Similarly other members of the gharial group were not tolerated near the hatchlings. However, at other times all members of the group are extremely tolerant towards each other.

It is not known how far captive observations such as these can be extrapolated to nature. To date we know of no data demonstrating parental care by any male crocodilian in the wild other than the vigorous response shown by crocodilians of both sexes to the distress call of hatchlings. However, in the relatively confined space available in captivity as demonstrated above and also by del Toro (1969), Hunt (1969, 1973, 1975), Lever (1975) and Lever and Balson (1978), the male may share parental care duties with the female.

There may be considerable interspecific differences in parental care behaviour by either sex. This is strongly indicated for instance for *C. porosus* in the wild (Kar 1981) and by the differing parental care profiles of the two pairs of *Caiman crocodylus* reported on by del Toro (1969) and Hunt (1969).

As discussed by Bustard and Choudhury (1980) parental care, which clearly has survival value is also limited by the ability of the mother to efficiently protect the typically large hatchling brood. Any part of the parental care burden shared by the male, therefore, will further increase the survival value of parental care.

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20. GROWTH AND BEHAVIOUR OF A BLIND GHARIAL *GAVIALIS GANGETICUS* (GMELIN)

(*With a text-figure*)

INTRODUCTION

During the operation of a large-scale conservation programme for the gharial, we have incubated 1062 eggs collected from the Narayani and Kali rivers in Nepal and the Chambal river in Madhya Pradesh. Occurrence of eye defects, among a total of twelve types of congenital defects, was the most common for eggs collected from the Narayani-Kali-Gandaki rivers originating in Nepal (Singh and Bustard, in prepn.). The various eye defects ranged from simple defects relating only to ciliary muscles to complete absence of one, or more commonly, both eyes. Seven embryos developed without eyes four of which were found dead in the egg. In addition one embryo developed with only the left eye present. The individual reported on here is the only one to have survived. The present paper discusses the case history of the only surviving blind gharial, in particular its growth and behaviour from its hatching in June 1975 to January 1981 a period of about 6 years.

MATERIALS AND METHODS

The individual reported on here hatched from one of seventy-two eggs collected immediately following laying and incubated in hatchery conditions described by Singh (1978) and Bustard and Singh (in prep.). Besides 40 normal young, one young with defective umbilical constriction, and two, one dead and the other alive, with complete absence of eyes, were surgically removed from their eggs by the second author on 23rd June 1975 after a period of 76 days incubation. The surviving blind hatchling was the heaviest of the brood with a hatching weight of 94.8 g and length 36.0 cm against a mean weight of 75.3 g and length of 35.8 cm (N=40). It had a normal amount of residual yolk. Along with the normal hatchlings the blind hatchling was reared under simulated natural conditions in captivity at the Gharial Research and Conservation Unit, Tikerpada. The normal rearing techniques are described by Bustard (in FAO 1975) and Singh (1978). The blind gharial was always kept in the same pool with its own hatchmates, ten in number, and trained to accept food from the hand ('hand-fed') from the age of three months. (In force-feeding the food is introduced into the mouth and pushed towards the throat when normal swallowing takes place).

OBSERVATIONS

1. *Swimming*: The blind gharial performed typical gharial swimming behaviour using the tail aided by the hind limbs. A peculiarity

observed, however, was that it often showed a circular swimming pattern as if moving around a central point. There was no indication of any preference for clock or anti-clockwise movement.

2. *Hauling out and basking*: Hauling out of the water was extremely rare during the non-winter season and when it did emerge it usually basked on the half submerged pool wall or branches of aquatic plants. When it hauled out of the pool, it usually kept a foot or the tip of the tail dipped into the water like a temperature sink in thermoregulating gharial (Singh 1978).

3. *Feeding*: As a supplementary diet, commencing about a month after hatching, it was 'force fed' daily with one or two stunned fish of suitable size. When it and its pool mates were 'hand-fed' it exhibited normal behavioural displays including responding to the sound of water splashing in a bucket of fish and opening the jaws when a fish was thrown

TABLE 1

MEASUREMENTS OF THE BLIND GHARIAL
(Length in mm and weight in kg)

Date	Snout	Snout vent	Tail	Total body length	Weight
23.6.1975	—	167	193	360	0.095
21.7.1975	50.0	179	218	397	0.090
21.6.1976 (1 year)	111.0	341	382	723	0.580
7.6.1977 (2 years)	155.0	472	505	977	1.550
10.7.1978 (3 years)	195.0	630	685	1315	5.000
17.7.1979 (4 years)	250.0	840	780	1620	10.2
16.6.1980 (5 years)	280.0	950	910	1860	15.4

TABLE 2

MEASUREMENTS FOR NORMAL GHARIAL
(Length in mm and weight in kg)

Date	Snout	Snout vent	Tail	Total body length	Weight
Hatchling	29.7	164.8	193.0	357.9	0.075
1 year	125	517	500	1017	1.9
2 years	180	738	682	1420	6.9
3 years	252	1086	1010	2096	23.9
4 years	302	1368	1108	2476	48.9
5 years	326	1538	1250	2788	71.8

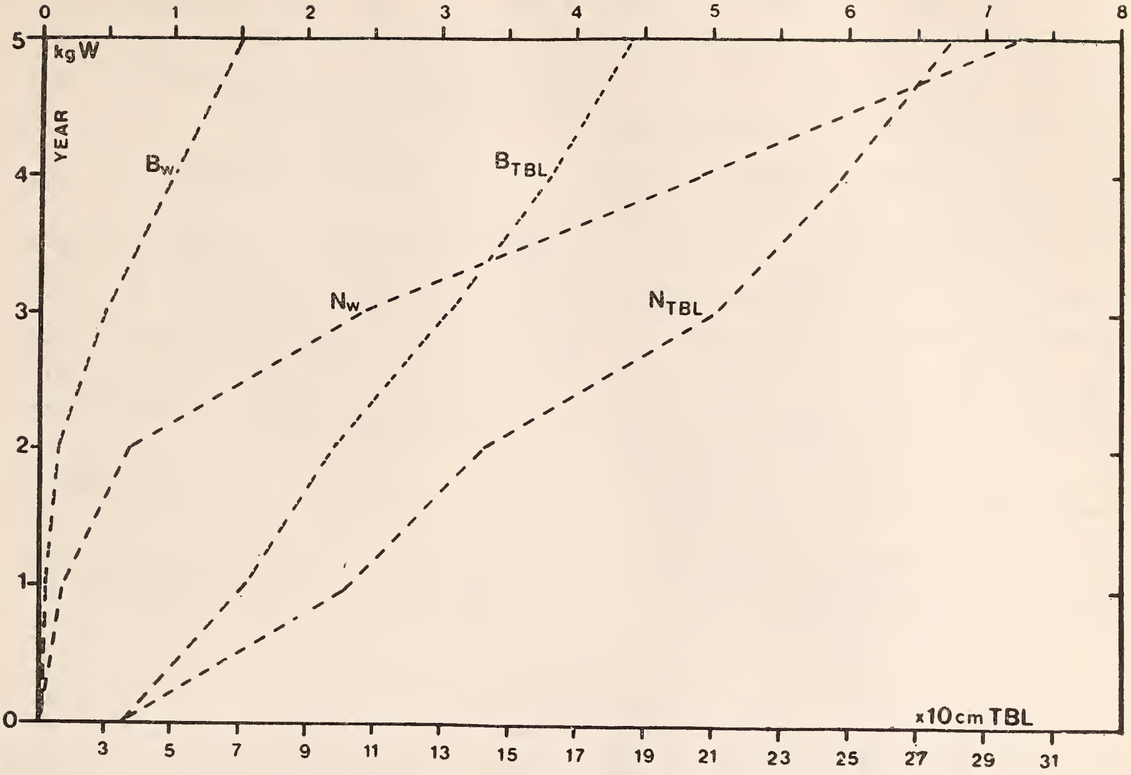

Fig. 1. Comparison of growth in total body length (TBL) and weight (W) between the blind gharial (B) and normal gharial (N) over the first five years of life.

near it. It was further noted that its sense of touch and hearing were even better developed than the already well developed condition in normal animals.

4. *Social relation with other animals*: All its pool-mates, though of similar age soon outgrew it, yet they appeared to be tolerant of the blind individual even at the time of feeding. If it came towards them they preferred to move aside. Similarly, at the time of hauling out, basking and surfacing, if it climbed over the body of others, they did not object. Furthermore, on no occasion have the normal animals been seen to victimise or even show their 'playful snout-stroking' behaviour (Singh 1978) towards it.

5. *Growth*: Five years' growth data for the blind gharial is presented in Table 1 and for normal gharial in Table 2. As indicated in the Tables, the blind gharial's growth was slow in comparison to normal animals. The growth in weight and length for the blind gharial compared to normal individuals is shown diagramatically in Figure 1. However, at no time was it underweight with respect to its length.

DISCUSSION

The cause of death of the other blind individuals is not known. The other two without eyes died after nine days and one month respectively and the one-eyed individual died after twenty days. These individuals were of normal size or slightly smaller.

We are likewise unable to explain the slower growth of the surviving individual whose weight in proportion to its length has been normal throughout (Figure 1). There would appear to be deleterious side effects to blindness quite apart from the inability of such individuals to emerge from the eggs unaided.

We consider the reason for keeping a foot or the tip of the tail in the water when it hauled out on the pool perimeter was to guide it back to the water since experiments indicated that once removed from the immediate vicinity of the pool it could relocate it only by trial and error movements.

ACKNOWLEDGEMENTS

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21. TRAP USED FOR CATCHING A MUGGER (*CROCODYLUS PALUSTRIS*) FROM NATURE

(*With three text-figures*)

INTRODUCTION

Between 1977 and 1979, during the breeding season, a female mugger of the Satkoshia Gorge, River Mahanadi, Orissa showed strong sexual attraction towards captive males at the Gharial Research and Conservation Unit (GRACU) which is situated on the banks of the river. On 31 Jan. 1979, the mugger was sighted near the mugger enclosure of GRACU at mid-night. She was surrounded from all sides with suitable strawed-bamboo mat covers, and then skilfully directed into the mugger enclosure. On August 4, 1980 she broke through the wiremesh wall of the enclosure and returned back to the river. Data collected to this stage have been reported earlier in Singh 1979 and Singh (in press).

During 1980 post-monsoon she again displayed a behaviour suggesting her intention

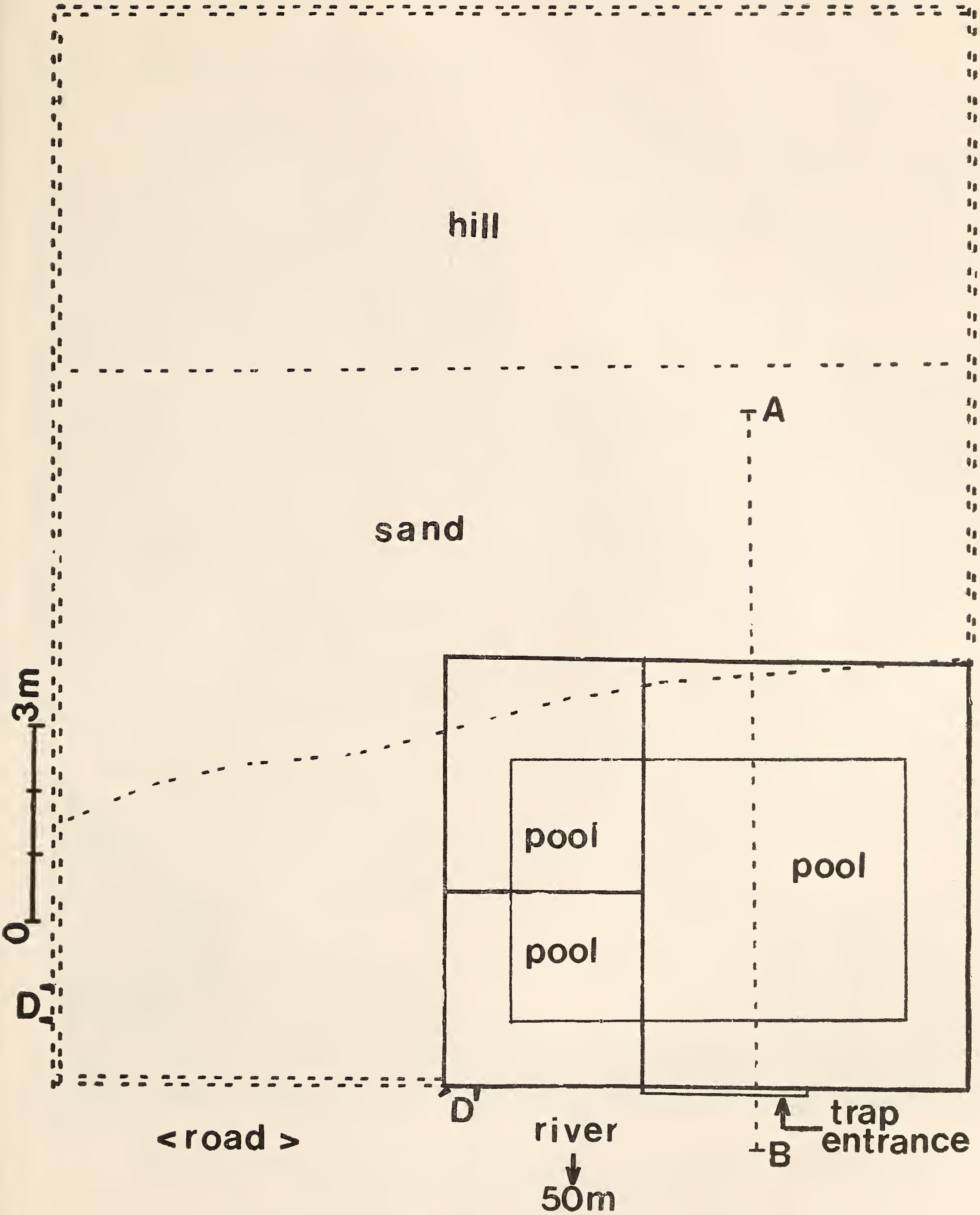
hill
sand
A
B
pool
pool
pool
0
3m
D
D
<road>
river
50m
trap entrance

Fig. 1. Ground plan of the Mugger enclosure at GRACU, over which the trap was designed to catch the female mugger from nature. AB, plane through which section have been taken for Fig. 2. D, door.

to enter into the enclosure where captive male muggers had still remained. This situation demanded the design of a trap to catch her, because waiting to see her near the enclosure and then to catch her was extremely difficult, though not impossible. Earlier experience was that when we wait for her to climb the banks and come near the enclosure, she would not do so, perhaps because she was able to detect our presence.

CONDITIONS OF THE TRAP

Any live trap would require a precise knowledge of the behaviour of the animal to be trapped, which was well studied in the present case. The work of trapping was facilitated because the female came near the enclosure and searched for a way into the enclosure. The males in the enclosure were the source of attraction for the female. The requirement in designing the trap, therefore, was to provide a passage into the enclosure which could not be used by those inside to come out. The other requirement was to trap the female unhurt.

TRAP DESIGN

The enclosure in which the male muggers were housed (Fig. 1) was of 16 x 14 m area with two small pools and one large pool. Only the pool area with near by basking areas was provided with a roof cover, the rest was open.

Over a surface of 2.5 x 1 m the lower sheet of wiremesh was removed from the front wall of the enclosure facing the river. The removed sheet was folded inside over a bamboo-frame platform, held from the roof of the enclosure by strong wire tied at two points, and supported from the bottom by strong poles. The inside edge of the platform remained hanging over the water surface of the large pool at a height of 1.5 m from water. The outer edge of the platform, now standing on the outer massonry wall, 0.35 cm high, of the enclosure was provided with a gentle slope of sand levelling down to the ground. On the platform light leafy branches were spread with straw and covered with a 10 cm thick layer of earth (Fig. 2).

During February 1981 the female mugger

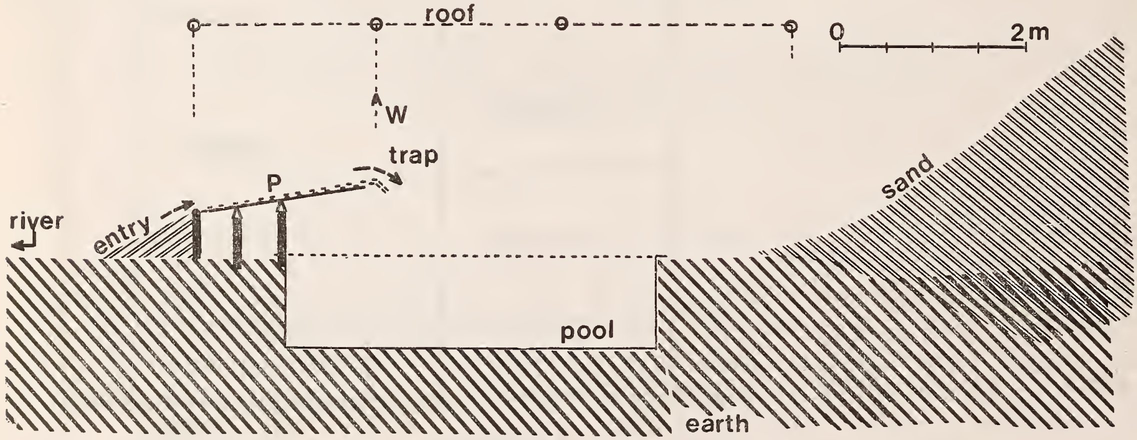

Fig. 2. Vertical section along A-B plane (Fig. 1) to show the design of the trap. P, platform; W, wire holding the platform to roof ot the enclosure.

entered through the trap and fell into the pool, to be detected by the staff of the Unit later.

DISCUSSION

In crocodile management catching a crocodile unhurt may be required at times. For example, situations may arise to catch a male or a female to support captive breeding, or to catch and remove a nuisance crocodile from the natural population. Live capture techniques have been described in the literature for the American Alligator (*Alligator mississippiensis*) by Chabreck (1965), Jones (1968), and Murphy and Findley (1973), and for the Saltwater Crocodile (*Crocodylus porosus*) by Webb and Messel (1977).

The live-capture technique described in the present paper was for a specific situation, where enclosures were present on the river bank, the males acted as the 'bait' and the female from nature was only searching a way into the enclosure. The requirement was to provide a one-way passage. However, the technique can be suitably modified for use in the field in catching crocodiles which come out of water being attracted towards a putrifying food bait. Such a design is made in Fig. 3 and is open for testing.

GHARIAL RESEARCH AND CONSERVATION
UNIT,
TIKERPADA 759 122,
May 31, 1982.

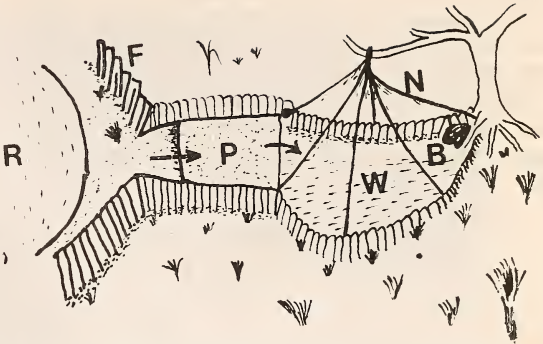

Fig. 3. Proposed design of a 'trap' to catch Mugger and Saltwater Crocodile in the wild. B, bait (e.g., food like goat intestine or any other meat); F, fence to direct the crocodile; N, a bag-like net held from the tree and spread at the bottom of the artificial pool (W). The opening into the net is fastened at W-end of P, the platform originating from the main water source.

Once the crocodile is known to have entered into the net, it can be untied from the tree and closed at its mouth fastened near P to be finally pulled out of water.

ACKNOWLEDGEMENTS

I thank, the Government of Orissa (Forest Department), Government of India, F.A.O. and U.N.D.P. and the staff at the Gharial Research and Conservation Unit, in particular, Sri D. K. Sahoo and Sri I. C. Sahoo, Research Assistants, for their help.

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22. SEXING AND SEX RATIOS OF GHARIAL (*GAVIALIS GANGETICUS*) RAISED IN CAPTIVITY

(*With a plate & a text-figure*)

Introduction

Determination of the sex of individual animals and the sex ratios of populations is an important tool in the study and management of Crocodilians. A pot like 'ghara' or narial excresence on the snout tip of adult male gharial distinguishes them from females, but otherwise sex of Crocodilians cannot be distinguished from external features. Therefore probing of the cloaca and examination of the penial/clitoral organ, hereafter referred to as the sex organ, is the only method of identifying the sex of individual crocodiles.

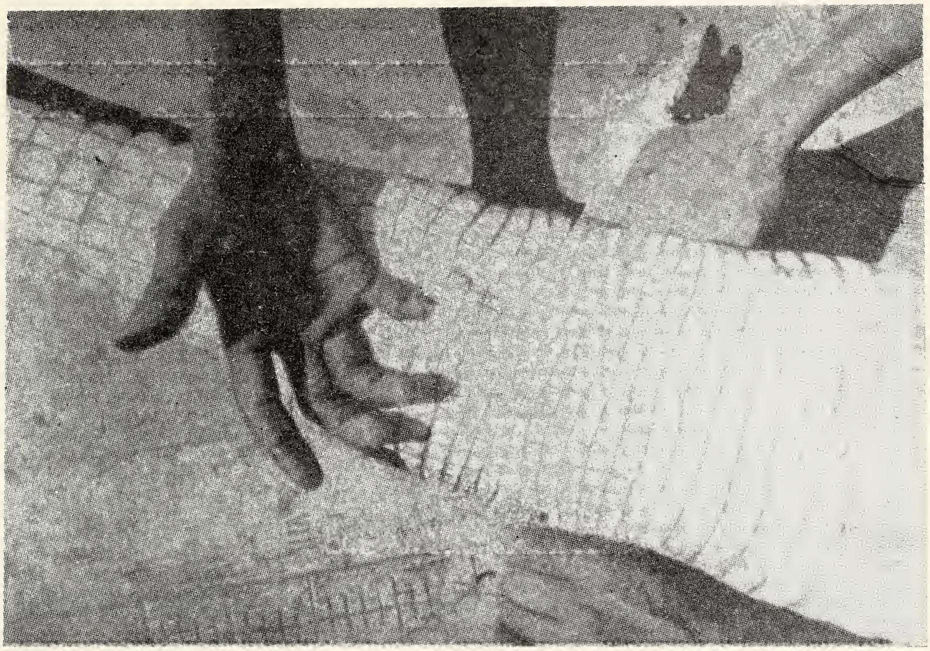
Whitaker *et al.* (in litt.) on the basis of cloacal probing of 20 gharial between 1 to 3 m in length state that it is difficult to sex gharial under 2 m in length. They further point out that a 2.7 m long male gharial 18 years of age had a penis only a few cm long and conclude that the sexual development of gharial is considerably slower than in other Crocodilians. M. V. Subba Rao (1981) states that the sex of gharial may be distinguished by cloacal probing if a minimum limit of 75 cm for total body length is observed while sexing gharial. V. B. Singh (1979) has reported on the sex ratios of gharial observed in nature.

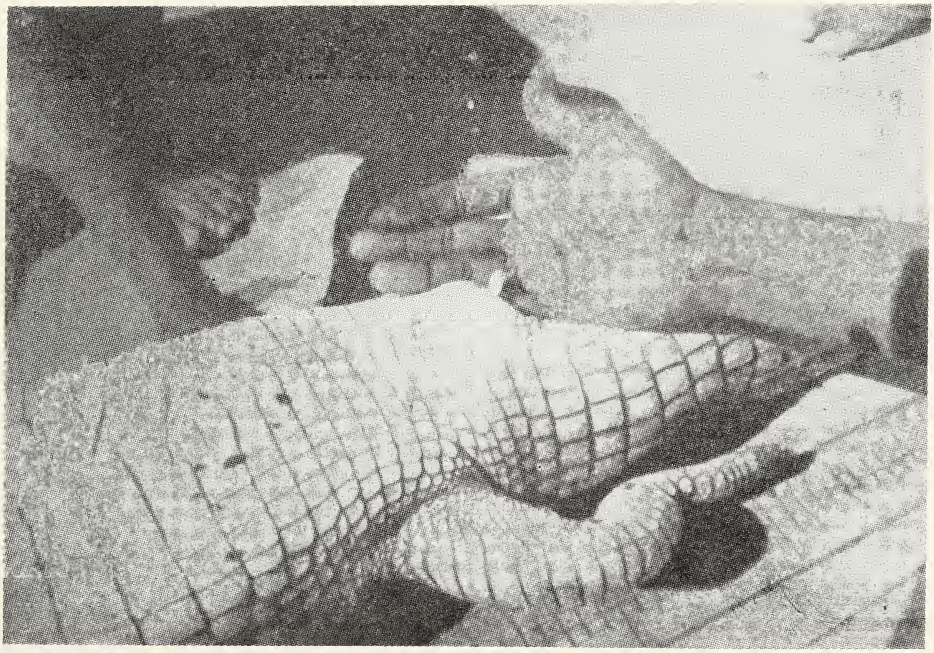
At the Gharial Rehabilitation Centre at Kukrail near Lucknow, sexing of juvenile gharial hatched from eggs collected from the Chambal river and reared at the centre, was done by probing of the cloaca on animals upto 4 years of age. After initial difficulty in unambiguously distinguishing the sex of animals, it was observed that in relation to the total body length, gharial displayed discretely differential development of the sex organ. This paper describes the basis for sex distinction in cloacal probing of juvenile gharial and sex ratios determined in different age classes of captive raised juveniles. Production of different sexes in Crocodilians has been discussed in light of sex ratios of captive and wild populations reported for other Crocodilian species.

Methods

Probing of the cloaca and extrusion of the sex organ was done with the little finger of the right hand. Prior to probing the finger was neatly manicured and the hand of the examiner and the cloacal vent of the gharial was cleaned and freed of sand particles by washing with a solution of potassium permanganate. Vaseline was used in cases to facilitate probing. The sex organ which lies forward of the anterior extremity of the cloacal vent was located and extruded by the finger to reveal it's floral tip for examination.

The sex of the animal was then distinguished on the basis of appearance of the sex organ





Above: View of an extruded female clitoral organ.
Below: View of an extruded male penial organ.

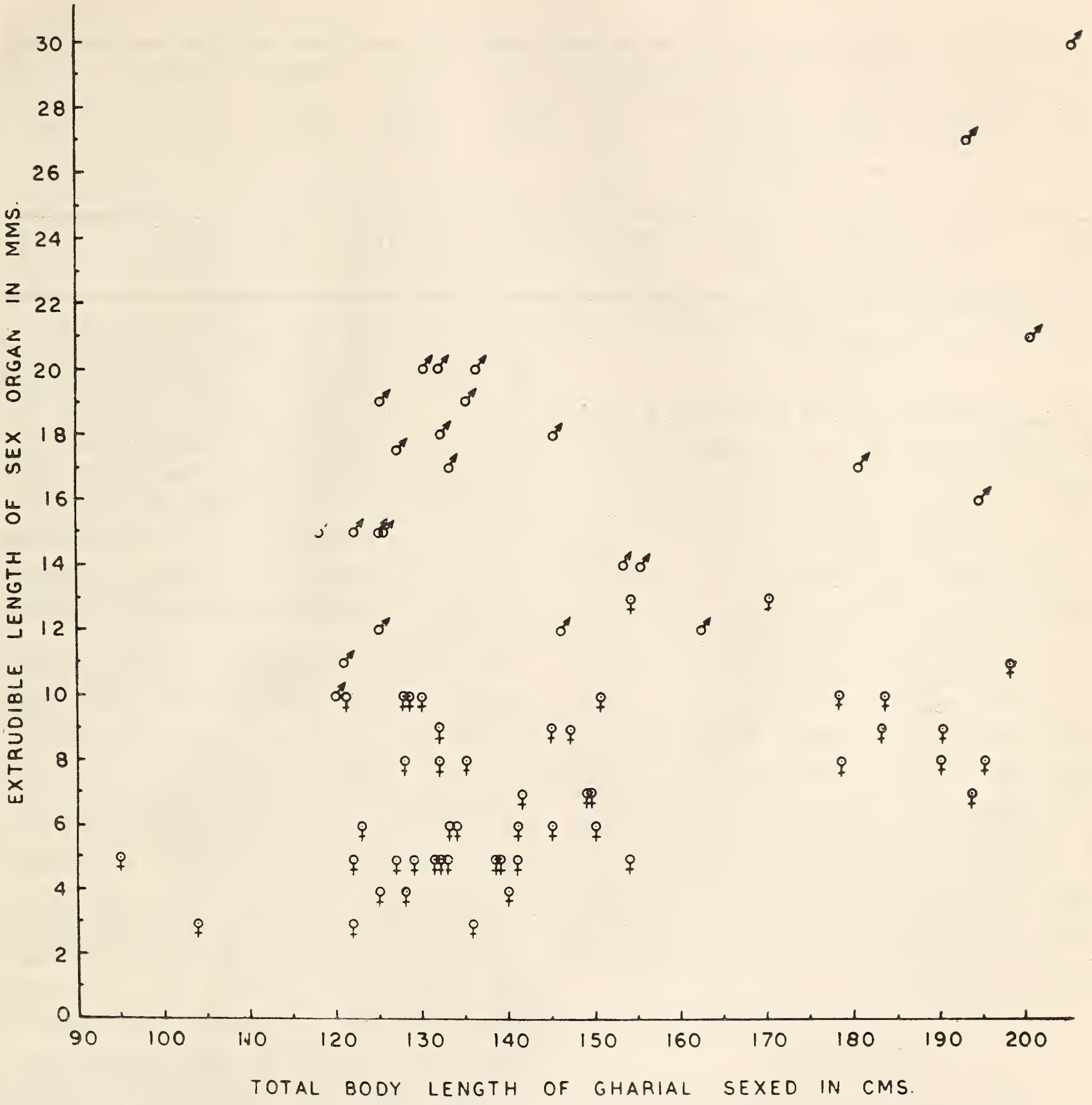


Fig. 1. Relationship of total body length of gharial to penial/clitoral organ length in different sexes.

(length, thickness and floral tip development). This fell into two broad categories illustrated in plate 1. The total body length of the gharial and the length of the exposed portion of the sex organ, after manipulating for maximum extrusibility were then recorded. The extrusible length of the sex organ was plotted against total body length (figure 1).

Table 1

Year hatching	Number of clutches collected	Number of eggs collected	Number of Gharial surviving at the time of sexing	Percentage survival	Number of males	Percentage of males	Number of females	Percentage of females	Male is to female ratio
1976	6	225	190	84.4	52	27.4	138	72.6	1:2.65
1977	12	513	282	55.0	187	66.3	95	33.7	1:0.51

Results

Cloacal probing was not possible in a group of gharial below 80 cm in length (average length 80 cm), as the size of the cloacal vent did not permit insertion of the finger without causing great inconvenience or fear of injury to the animal. The length of the smallest gharial whose cloaca could be successfully probed was 96 cm and the length of sex organ in this case was 5 mm. Of the 81 gharial whose sex organs were measured, the mean extrusible length of 27 gharial distinguished as males was 17.1 mm (mean total body length 144.53 cm), while the mean extrusible length of the sex organ of 54 gharial distinguished as females was 6.9 mm (mean total body length 147.23 cm). See also fig. 1. The percentage constituents of different sexes and the sex ratios of two successive age classes are given in Table 1.

Discussion

The incubation of gharial eggs collected from the Chambal river for hatching at the Gharial Rehabilitation Center, Kukrail is generally semi-completed (40 out of total 60-65 incubation days) in situ and the development of male and female embryos may be assumed to be the same as that in nature. Singh (1979) reported a male to female ratio of 1:2 in the Chambal river and 1:4.5 in the Girwa river for wild adult gharial. Although the above figures deal with extremely small remnant populations they imply that greater numbers of females are produced in nature and/or survive to adulthood. This is in agreement with the observed proportion of females hatched from eggs at Kukrail in 1976 (72.6%), see Table 1.

The greater proportion (66.3%) of males observed among gharial hatched from eggs in 1977 may be due to sex-specific mortality among the females of that year. Of the gharial hatched in 1977 only 55% were surviving at the time of sexing, as compared to 84.4% of gharial of the 1976 batch which were surviving at the time of sexing.

Among other crocodilians Kar and Bustard (1980) have reported production of extremely high proportion of females for *Crocodylus porosus* hatched in captivity. The male to female ratio observed by them in two successive age classes were 0:100 and 1:13.66 respectively. Cott (1961) quoted in Turner (1977), judged the male to female ratio of *Crocodylus niloticus* as 1:1 on the basis of a collection of 324 males and 327 females while Chabreck (1966) also quoted in Turner (1977) states that a surplus of males seem to be typical of all size classes in alligator population, on the basis of sex determination of 186 alligators killed at random by hunters (60.8% males) in one instance and of 46 adults (60.1% males) in another instance. However Turner (1977) comments that Chabreck's above observation may be biased in favour of males which were selectively killed, as "females in captivity were extremely timid and rarely seen except during courtship and nesting periods", Joanen and McNease (1971), quoted in Turner (1977).

It has been hypothesized for turtles that embryonic production of sexes is co-related to incubation temperatures (reference not aavilable with the authors) and this may also be true for Crocodilians, but a relevant question which emerges in this context is whether evolutionary selection has opted for selective production of males or females. Either case may have it's own survival significance. Production of greater numbers of females will result in optimum utilisation of available habitat by the polygamous Crocodilians in terms of returns in off-spring production, while production of greater numbers of males will ensure fertilization of all available females.

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D. BASU

October 1, 1981.

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23. GECKO FEEDING ON A MOUSE

Our bungalow in the scrub-jungle is inhabited by a number of large geckoes (*Hemidactylus leschenaulti*), and one evening about 8 p.m. I observed a large gecko (about 5 inches in total length), in our kitchen, snatching by its head, a young mouse (*Mus musculus*) (about 1½ inches in total length), running on the rafters. It then started hitting the mouse against the wall repeatedly, very much as it does with cockroaches or other insects, or as some birds do with their live-prey. At the same time, the gecko squeezed the head of the mouse within its mouth, and waited for a long time, till I presume, life was extinct in the mouse. It then started swallowing the mouse, head first and took nearly 15 minutes to swallow the whole lot, as slowly as a python does.

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August 21, 1979.

STEPHEN SUMITHRAN

24. A NEW RECORD OF *SALMO TRUTTA FARIO* LINN. FROM GOBINDSAGAR RESERVOIR

The fish fauna of Gobindsagar and its associated waters has been described by various workers Bhatnagar (1973), Tilak & Hussain (1977), Sehgal (1974), and Sharma *et al.* (unpublished) but occurrence of trout has not been reported from this reservoir. Observation on occasional occurrence of this species in the reservoir after 1977 were made in 6th Workshop Report. However the first confirmed record of *Salmo trutta fario* Linn. (T. L. 280 mm; T. W. 250 gm.) was from Damera Ghat, in Lathiani area, in April 1981, and another weighing 2.250 kg, caught in 155 mm mesh size gillnet near Berighat at Bilaspur, giving credence to the information about stray occurrence after construction of the Beas-Sutlej link. The specimen obtained from Lathiani had the following characteristics:

Fin formula: D. 12 (3/9); A. 10 (3/7); P. 14; V. 9 (1/8); C. 18. Total length: 290 mm; Weight: 250 gm; Standard length: 253 mm; Furcal length: 273 mm.

Sutlej has trout streams (Baspa) and is serviced by trout hatchery (Sangla), but trout were never caught below Rampur. There was no report of trout from this reservoir which came into existence in 1964 after construction of dam at Bhakra; or till the Beas-Sutlej Link canal, completed in 1977, bringing water of Beas river in considerable quantity from Pandoh reservoir. Beas river has extensive trout streams in its course, besides Pandoh reservoir itself yielding considerable quantity of trout every year, from its inception; besides it is serviced by two hatcheries (Katrain and Patlikuhl or Naggar). This suggests the possibility of trout entering Gobindsagar from the river Beas through the Beas-Sutlej Link. Which ever may be the source, its occurrence in Gobindsagar, that too in Lathiani area (Lunkhar Khad) and Bilaspur are of interest as the surface water temperature remained between 24°C. and 17°C. in the area.

Reservoir Fisheries Project,
Central Inland Fisheries,
Bilaspur (H.P.) 174 001,
October 19, 1981.

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Y. RAMA RAO

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25. RECENT RECORDS OF GARHWAL MAHSEER (*TOR PUTITORA*) WITH A NOTE ON ITS PRESENT STATUS

(*With a text-figure*)

This contribution deals with the rare records of mahseer, both past and present ones. The latter includes 28 Kg and 23 Kg putitor mahseer recorded by us from the rivers Alaknanda and Nayar, respectively. Though *Tor putitora* is a game fish, in the Garhwal hills it has achieved a commercial status. But on the other hand gradual decline can not be totally ruled out, attributed to its overexploitation. We suggest induced breeding as a measure to protect and propagate mahseer instead of awaiting for convincing proof of its depletion. The Central or the State Governments should come forth with financial assistance for such projects.

INTRODUCTION

For the past one century mahseer have been known to provide good sport. This favourite game fish has shown a gradual decline, attributed to indiscriminate fishing of broodfish and juveniles, pollution, low fecundity, cannibalism etc. (Raj 1945, Pathani 1977, 1978, Das & Pathani 1978, Kulkarni & Ogale 1978, Nautiyal & Lal, in press). The principal species inhabiting the rivers and lakes of the Central and the Western Himalayan sector are *Tor putitora* (Ham.), *Tor tor* (Ham.) and *Tor progenius* McClelland.

The Garhwal region lies in the Central Himalayan sector and the hillstreams of this region harbour only two species, namely *Tor putitora* and *Tor tor* (Badola 1975). In the present contribution we have dealt only with *Tor putitora.*

One of us (P.N.) while on a collection trip to Banghat (a fish landing centre of river Nayar, Fig. 1) and nearby areas, collected a number of large mahseers of which a female specimen of *Tor putitora* weighed *c.* 23 Kg. and measured 137.7 cm in length. Mahseer ranging from 5 Kg to 14 Kg were commonly landed either by angling or by gill nets (Nautiyal & Lal, in press) during July-September. In fact they migrate upwards from the Ganga to the foothill stretches to spawn in some of its tributaries during these months. Similarly, we have recorded heavy mahseers from the river Alaknanda during March-April (1981) weighing about 7.800 Kg 10.500 Kg, and 12.50 Kg. Previously, in the year 1978 a large mahseer weighing 28 Kg was also observed by the second author (M.S.L.). It was caught by a local angler. Besides these records we have unconfirmed information from the fishermen inhabiting the Nayar valley that they landed two heavy mahseers weighing about 52 and 38 Kgs during August, 1981. It is obvious that giant mahseers still frequent the hillstreams of the Garhwal Himalayas.

PRESENT STATUS OF GARHWAL MAHSEER

Kulkarni & Ogale (1978) have discussed the status of mahseers and have commented that sport fishing had shrunk considerably in recent years and had resulted in disappointing reports on their numbers and size. They also reported that the status of *T. khudree* was in no way better in Maharashtra rivers like Bhima, Koyna etc. where the fish has become a rarity. The situation is similar in South India also. Karamchandani *et al.* (1967) have reported a remarkable decline in the fishery of *Tor* mahseer from Narbada and

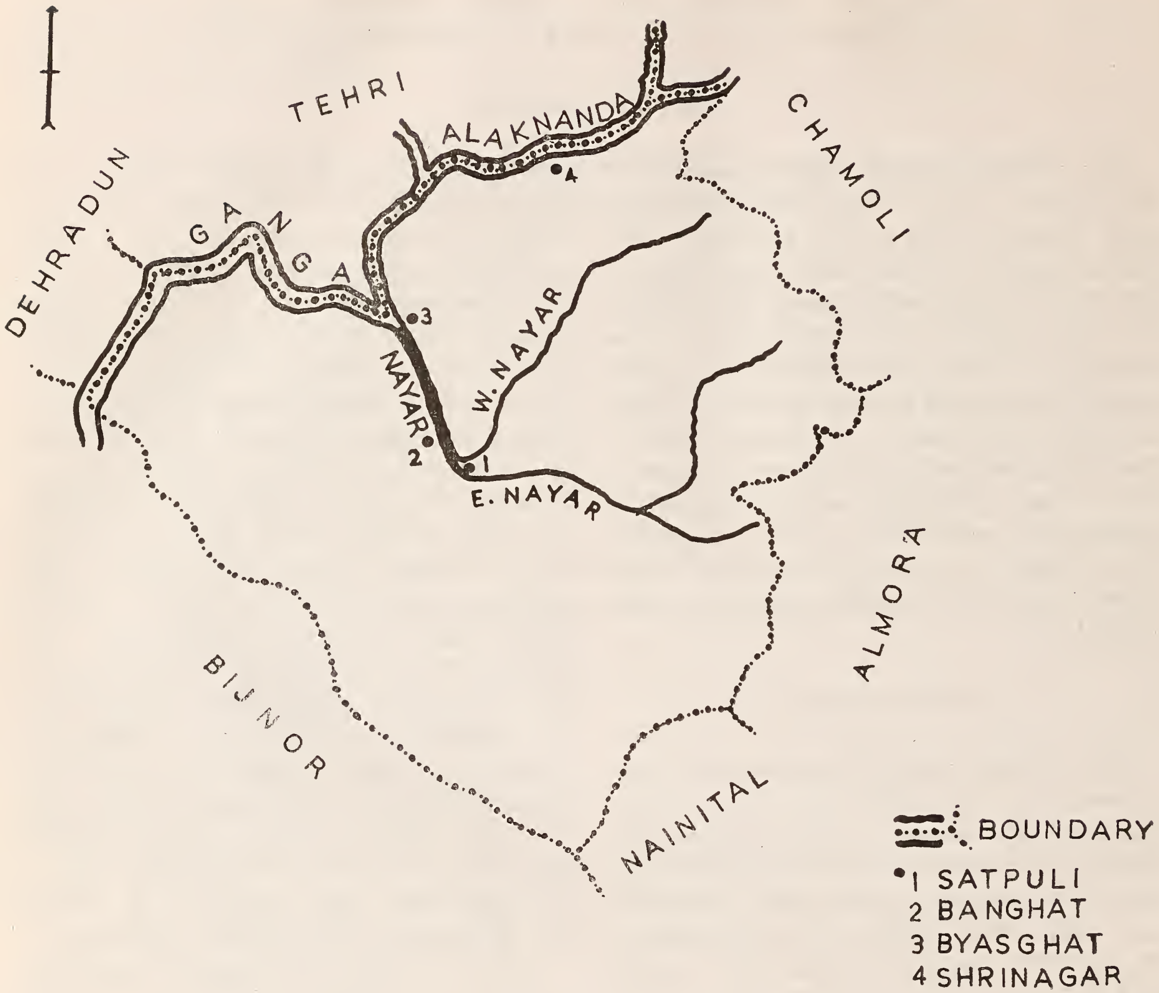
TEHRI
ALAKNANDA
CHAMOLI
DEHRADUN
GANGA
NAYAR
W. NAYAR
E. NAYAR
ALMORA
BIJNOR
NAINITAL
BOUNDARY
1 SATPULI
2 BANGHAT
3 BYASGHAT
4 SHRINAGAR

Fig. 1. Map showing the rivers explored and some important fish landing centres surveyed in Pauri Garhwal District.

Tapi rivers in Madhya Pradesh. Sehgal (1972) has assessed that in Jammu, Himachal Pradesh and Uttar Pradesh, the ascending and descending mature individuals mainly constituted the putitor mahseer fishery. Sehgal's (1972) and our observations tally, for in the Garhwal region of Uttar Pradesh not only the brood fish but also the juveniles were exploited for its fishery. In fact the latter constitute a major part of the fishery, the brood fish being available for a limited period only. Thus the Garhwal mahseer has achieved a commercial status in this region.

Although it seems from the recent records of the mahseers from Nayar and Alaknanda rivers of Garhwal Hills, that Garhwal mahseer is biologically in a better position, it is being overexploited in this region also. We have observed local inhabitants using destructive fishing methods and we anticipate a fall in population. Earlier, M. L. Mehta gave a vivid pen picture in Times of India (6.6.1976) of the immoral destruction of mahseer in the rivers near Dehra Dun (U.P.). We should not await further proof of its depletion for instituting conservation measure as then it may be too late to undertake any rehabilitation measures.

C/o. SHRI N. M. MISHRA,
GOLA BAZAR,
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PRAKASH NAUTIYAL

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26. EXTENSION OF RANGE OF *ENNEAPTERYGIUS OBTUSIROSTRE*, WITH NOTES ON ITS ECOLOGY

(*With two text-figures*)

In the handnet catches from the tidepools off Visakhapatnam (17°41′ N, 83°17′ E) specimens of *Enneapterygius obtusirostre* (Kluzinger) were a regular feature. The species is so far known only from the Western Indian Ocean (Smith 1961). As such the present record from Eastern India forms an additional distributional record.

Description: D III, XIII (XII in one specimen, XIV in one specimen), 9-10; A I, 17-19; P 15-16; V I, 2; C 9; lateral line series 34-36 (33 in one specimen); gill rakers 0+1+6 (one may be rudimentary on long arm).

As percentage of standard length: total length 118.46-126.42; body depth 18.03-24.59; head length 30.0-35.85; snout length 8.0-11.54; eye diameter 0.8-11.48; interorbital distance 3.23-4.92; postorbital 13.33-18.75; pastoral length 30.0-33.85; ventral length 20.0-25.0; depth of caudal peduncle 7.69-10.0; distance from snout tip to dorsal 22.64-30.0; to anal 50.0-56.14, to pectoral 29.51-35.09, to ventral 18.87-28.07.

As percentage of head length: Snout length 25.0-35.29; eye diameter 26.32-35.0; interorbital distance 0.09-15.79; postorbital 44.0-56.25.

SIZE:

Body deepest below first dorsal, scales ctenoid, head and basal part of first dorsal naked, head dorso-ventrally flattened, mouth moderate with snout slightly produced, teeth minute, curved and sharp in a single row anteriorly, vomer and palate devoid of teeth; eyes large, maxilla reaches below anterior margin of eye; single nasal cirrus, supra-orbital cirrus leaf-like, simple, sometimes with 2-4 free tips; pre-opercular margins and angle smooth; 3 dorsal fins present, first two fins with delicate spines, first spine of the first dorsal is the longest, dorsal rays longer than spines and reach 1/3 of caudal peduncle; anal rays longer than the spine and reach 2/3 of caudal peduncle when folded back, ventral does not reach vent, pectorals reach beyond vent, caudal truncate with edges round.

Colour: FEMALE (Fig. 1) — Very pale brown with orange and brown melanophores which more or less form 5 irregular oblique bands on body. Chin and throat possess only orange melanophores. Chest and belly white without any melanophores. Dorsal fin hyaline, the membrane between first and second spines of first dorsal is black. Other fins pale yellow, base of pectoral has an inconspicuous brown blotch, caudal with 4 vertical, discontinuous bands.

MALE (Fig. 2) — Grey with vague bands, nape brown with black melanophores. The spaces between nares, postorbitals, bases of pectorals, pelvics and belly are orange. Cheeks, chin, throat, part of operculum and pectorals are lustrous green with blue spots in live condition and turn black after death. A prominent blue black ocellus on the base of pectoral, 2 black longitudinal lines on second dorsal, dark grey anal are characteristic.

Ecology: This little fish occurs only in lower level tidepools which are totally exposed during low tides. As such the salinity of the pool water varies from time to time and sometimes touches 43‰ during summer when low tides prevail for long periods. The

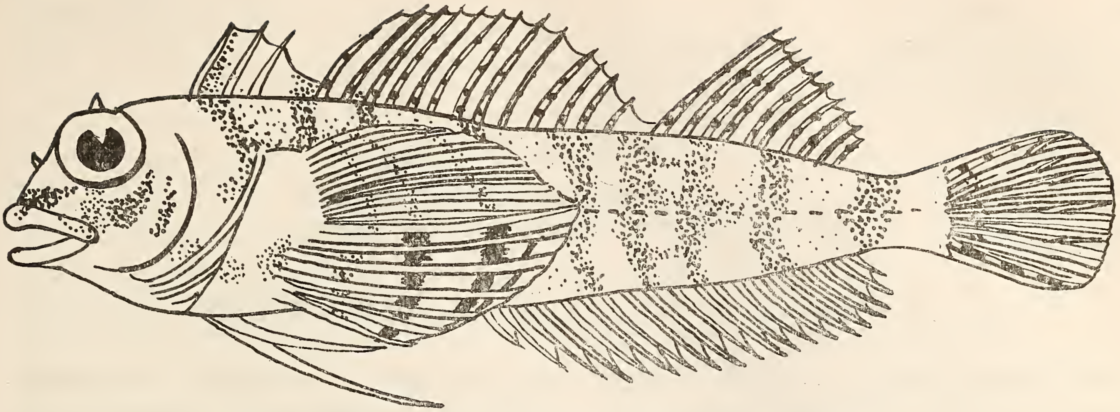

Fig. 1. *Enneapterygtus obtusirostre* (Kluzinger): Female.

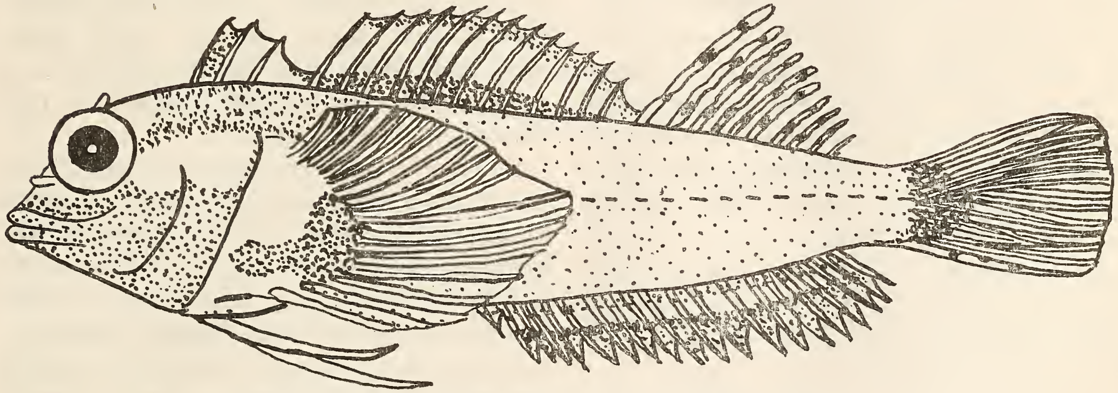

Fig. 2. *Enneapterygtus obtusirostre* (Kluzinger): Male.

diel oxygen content and pH varies abnormally as does the temperature. It is an excellent example for camouflage and concealment and is rather difficult to locate as it blends perfectly with the weeds. They are encountered all through the year but more frequently during October-February which is apparently their breeding period. The chief food for this fish is the phytal fauna occurring on the algal thalli of *Enteromorpha, Caulerpa,* etc. This tiny fish picks up the tinier fauna with utmost delicacy, aided by the large pectorals and wide eyes. It also eats small molluscs.

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27. ON A FREAK OF *ISTIBLENNIUS STRIATOMACULATUS*

While studying the fish fauna of rock-pools along the coastline between Visakhapatnam and Bheemunipatnam (17°40′-54′N, 83°16′-28′E), a blennid fish possessing abnormal vertical fins was collected on August 10, 1979. It was identified as *Istiblennius striatomaculatus* (Kner 1866) Smith-Vaniz & Springer (1971) of the tribe Salariini in the family Blenniidae. A brief description of this abnormal fish is provided with a comparison of its features with those of a normal fish of about the same standard length.

The specimen is characterised by D XIII, 20; A III, 22; p. 14; V I, 3; C 3; supra-orbital cirri 6; nasal cirri 2; gill rakers 2+1+12.

Percentage of Standard Length:

Total length 112.77; body depth 20.21; head length 23.40; eye diameter 6.38; inter-orbital distance 2.13; orbital cirrus 5.32; nasal cirrus 2.13; distance between dorsal notch and caudal base 44. 68.

Percentage of Head Length:

Eye diameter 27.27; inter-orbital distance 0.09; orbital cirrus 22.73; nasal cirrus 9.09.

The body is anguilliform and naked with prominent forehead and eyes, nasal cirrus twice branched and supra-orbital cirrus having 6 branches. The spinous dorsal is a little lower than the soft dorsal, mid-spines being longer; the 13th spine is the smallest, lying hidden in the notch between the soft and spinous parts of dorsal. Membrane of the dorsal fused with that of caudal fin. Last dorsal ray comparatively much elongated, curved and continued parallel with caudal fin rays. Anal spines small and hidden, first spine positioned as a small papilla after the vent, and anal fin base adjacent to that a caudal fin.

Body olive with brown spots and streaks and 6 pairs of brown bands descend rather irregularly; under-parts lighter without any markings. A small black spot between the 1st and the 2nd dorsal spine and another between 2nd and 3rd dorsal spine. Spinous part of the dorsal fin with brownish wavy lines running posteriorly and inclining gradually towards the base. Rayed portion has several zigzag, lines. Pectoral fin pale with semicircular rows of brown spots. Caudal fin olive with brown spots arranged in semicircles.

This description conforms quite closely with that for *I. striatomaculatus* provided by Smith (1959). However, there are some deviations. The abnormal fish has an additional anal spine and only three caudal rays in the retarded tail as against 13 in the normal. Furthermore, the dorsal fin is united completely with the caudal fin and the anal has come to be very close to the caudal fin.

In taxonomic studies, it is a general practice to attach significance to the form and number of anal spines and caudal rays. The present specimen, as already indicated, shows deviations in these characters.

ACKNOWLEDGEMENTS

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28. ON THE OCCURRENCE OF *CRYPTOTERMES BENGALENSIS* SNYDER (ISOPTERA: KALOTERMITIDAE) IN GUJARAT, INDIA

Cryptotermes bengalensis Snyder was described in 1934 from the Sunderbans (21°40′-22°50′N and 88°10′-89°40′E), West Bengal (type locality) on the basis of imagos and soldiers. It has been since recorded from various places in India and Bangladesh (vide infra). This species has recently been collected at Kaprada Forests, Bulsar District in Gujarat, attacking dead portions of a living tree of *Tectona grandis* (Teak), thus extending its range westwards.

Material: A vial with six soldiers and several workers, Gujarat: Kaprada forest (Bulsar District), N. S. Rathore coll., 27.12.1980. Ex: *Tectona grandis.*

Measurements (*in mm.*) *of soldier*:

Total body-length with mandibles	4.9-5.6
Head length without mandibles	1.47-1.51
Maximum length of head up to frontal ridge	1.25-1.32
Median length of head up to frontal ridge	1.05-1.12
Maximum width of head	1.33-1.37
Length of mandibles	0.49
Maximum length of pronotum	0.84
Maximum width of pronotum	1.33

DISTRIBUTION: INDIA: *West Bengal*: Sunderbans, Jhingakhali forest. *Assam*: Digboi, Jokhai reserve forest. *Madhya Pradesh*: Mandla fort; Surhi village, Lormi range (Bilaspur); Kesli range (Hoshangabad) and Jaisinghnagar (Sahdol). *Tripura*: Belonia and Paratia. *Uttar Pradesh*: Gorakhpur and Ramnagar. *Gujarat*: Kaprada forest (Bulsar District), Present record. BANGLADESH: Dacca.

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29. INCIDENCE OF MASS ATTRACTION OF *CYDNUS INDICUS* WESTW. (HETEROPTERA — PENTATOMIDAE) TO LIGHT

Cydnus indicus Westw., the common black "geranium bug" has been found living in soil in large numbers. I observed in 1980 a good number of insects attracted to light including *Cydnus indicus* in this locality. In 1981 during the months of July and August an unusual phenomenon of mass attraction of this black bug was observed while making further studies on the phototropic responses in insects. On 29th July there was heavy rainfall at Saharanpur (45.0 mm.) and at 9.00 p.m. when rain had stopped, forty bugs were found around light source (60 Watt Bulb) and on the ground below. The same phenomenon was observed on 2nd, 15th and 22nd August. In another locality on the 27th August at 8.00 p.m. these bugs were watched emerging from soil and taking flight towards light source (fluorescent tube) situated at a distance of four metres. After taking a short flight around light, most of them fell down on the ground. Their number was counted and recorded as 43. Meanwhile, a toad *Bufo melanostictus* suddenly appeared and started feeding on the insects. Within half an hour it had consumed 35 bugs, but the rest were beyond its reach on the wall of the house.

On 29th July, we presume that the flooding of the soil compelled the bugs to emerge out from their hide outs and then to fly towards light. But, on 2nd, 15th, 22nd and 27th August, there was no rain at Saharanpur. So, it can be concluded that it is a normal habit to be attracted to any light source in the vicinity during the rainy months, i.e., from July to September, in this region.

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30. A NOTE ON THE OVIPOSITION OF *SPHAERODEMA RUSTICUM* (FABR.) (HEMIPTERA)

Sphaerodema rusticum is an aquatic bug and is commonly available in ponds at Dhar. These were collected and reared in aquaria. Breeding took place between February to mid November. It is an interesting example of parental care by the male.

In mating the male mounted on the back of the female and copulation lasted for an hour. Oviposition took place after 25 to 30 hrs of copulation. Female selected a male mounted upon it and laid an egg on the posterior extremity of the abdomen. The female then got down, again mounted on the same male and laid another egg just in the vicinity of the first. This procedure continued for about 4 to 6 hrs. in different cases. The female also excluded some adhering secretion which helped the eggs to adhere to the back of the male and a complete raft of eggs was formed. A female oviposited 60 to 70 eggs at a time. The male loaded with these eggs moved about till the hatching took place. Generally the hatching took place in about 10 days. On 11th October 1980, in an aquarium two females selected a male and started lying eggs alternately upon it. The number of eggs laid was 132.

In fresh collections of the animals from ponds also many males were found with the raft of eggs on their back. In such collection also once we found 138 eggs on the back of a male. It was also definitely due to the oviposition by two females on one male, as a female lays only 60 to 70 eggs at a time.

The Male *Sphaerodema* is an excellent example of parental care in hemipteran insects.

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31. NEW RECORD OF *PAUROPSYLLA DEPRESSA* CRAWF. ON *FICUS LUCESCENS* BLUME

During an insect collection survey in district Saharanpur, galls of *Pauropsylla depressa* Crawf. (Homoptera) were observed in large numbers on *Ficus lucescens* (=*F. infectoria* Roxb.). This is a new record on this plant. Mathur (1975)[1] has described the psyllid, *Psausia indica* Mathur from *F. lucescens.* Observations made during 1979 and 1980, on the incidence of the insect on *F. lucescens* are reported here.

Ficus lucescens Blume. has been found heavily infected by these galls throughout the year except September-November. Nearly 90 per cent leaves bear galls. Leaf-fall on this *Ficus* plant occurs during mid September and continues up to mid October in this locality. During this period, the older leaves containing galls fall and new foliage appears by early November. Oviposition by *Pauropsylla depressa* then takes place. Young galls can be seen in late November. Only second, third and fourth instar nymphs were seen up to mid January, but in late January, fifth instar nymphs were found in the galls. In first half of February, the adults were seen wandering over the foliage of the plant. Thus, in winter months (December and January) of this locality, the development of this Psyllid slows down to pass the colder weather in nymphal stages. As soon as the warm weather sets in during February, the adults emerged from the fifth instars. During the rest of the year, i.e., from February to October, all the stages were seen.

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[1] MATHUR, R. N. (1975): Psyllidae of the Indian Subcontinent. *ICAR publn.*, New Delhi, pp. 429.

Distribution in Saharanpur — Nakur (Sadholi, Kharibans, Gangoh), Deoband (Majri, Nomehra), Roorkee (Iqbalpur, Bhagwanpur, Haridwar, Jwalapur), Saharanpur (Panwarka, Behat, Rampur Maniharan, Kailashpur, Gagalheri).

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32. BUTTERFLIES FROM ANDAMAN ISLANDS WITH SOME NEW RECORDS

INTRODUCTION

Andaman and Nicobar Islands, situated in the Bay of Bengal between 6° and 14°N; and between 92° and 94° E, have been explored by several naturalists in the past. A consolidated list of butterflies was published Ferrar (1948) in this *journal*. Since then many changes have been taken place in the islands due to deforestation, and refugee settlement. During a recent visit to the Island with Dr. Sálim Ali, from the last week of January to the first week of March in 1980, I collected several specimens of butterflies and other insects. In this paper the status of the species collected is compared with the status as reported by Ferrar (op. cit). The collection was made at Chirria Tapu, Ross Island, and Port Blair in South Andaman, Mayabunder, Tugapur and Interview Island in Middle Andaman and Northreef Island, Aerial Bay (Diglipur) in North Andaman. One day was spent at Smith Island, Ross Island and Wharf Island all in the North Andaman. Though climatically the islands are more or less uniform there was difference in Vegetation. In some islands the tidal zone is occupied by thick impenetrable mangrove swamps and in others there are sandy beaches. In the latter the littoral or beach forest consists of some flowering bushes, Andaman bullet-wood and Pandanus trees. This zone is followed by semi-evergreen forest and Tropical climatic forest. It was observed that some Nymphalids and Pierids like, Maps, Wanderers, Orange Tips, regularly visit the seashore and settle on damp patches for a few seconds, while others like Sailers, Lacewings, Pansies, Blues confined themselves to the forested area. The Satyrs and Skippers remain within the forest.

ORDER LEPIDOPTERA

Family DANAIDAE

1. **Euploea andamanensis andamanensis** Atk.
Andaman Crow
As described by Ferrar, the species is very common throughout Gt. Andaman. Specimens were collected from Aerial Bay, Mayabunder and Chirria Tapu.
2. **Danaus chrysippus** (Lin.)
Plain Tiger
Not very common at Portblair as described earlier. A single specimen was collected from Portblair.

Family SATYRIDAE

3. **Orsotrioena medus medus** F.
Nigger
Common throughout Gt. Andaman as described earlier from December to March. Collected from Mayabunder.
4. **Melanites leda ismene** Crammer
Common Evening Brown
Very common throughout Andaman, I did not see a single specimen of *M. zitenius andamanica* recorded earlier from Andaman.

Family NYMPHALIDAE

5. **Apatura parisatis parisatis** Wd.
Black Prince
Rare, not recorded by Ferrar. Not rare in Burma. Specimen collected from Aerial Bay.
6. **Euthalia kesava** M.
Powdered Baron
Not rare, not recorded earlier. Collected from Mayabunder.
7. **Parthenos sylvia roepstorfii** C.
Clipper
Not rare as described earlier. Seen at Diglipur, Mayabunder, Chirriatapu. Collected from Wharf Island near Aerial Bay.
8. **Neptis hylas andamana** M.
Common Sailer
Common throughout Andaman as described earlier by Ferrar collected from Chirriatapu, Mayabunder, Diglipur, Aerial bay.
9. **Neptis soma mananda** M.
Sullied Sailer
Common, collected from Aerial bay North Andaman.
10. **N. hordonia** Stoll
Common Lascar
Common, collected from Mayabunder.
11. **Cyrestis thyodamas andamanica** W.M. & de N. Common Map
Not common as described earlier seen only at Chirriatapu. Regularly visits seashore and settles on damp patches.
12. **Hypolimnas bolina** L.
Great Eggfly
Not common in February, but Ferrar described it as common in September and October and again in June-July.
13. **Precis hierta** F.
Yellow Pansy
Very common. Found in areas cleared for settlement at Tugapur near Mayabunder and Diglipur.
14. **Precis almana almana** L.
Peacock Pansy
Common in open country, Collected from Diglipur.
15. **P. atlites** L.
Grey Pansy
As described earlier common in South Andaman. Collected from Chirria Tapu.
16. **Phalanta alcippe andamana** Pruh
Small Andaman Leopard
Not common in February, but Ferrar had seen these butterflies in clouds in April and again in October.

17. **Cethosia cyane** Drury
Leopard Lacweing
Not recorded by Ferrar. It is common at Chirria Tapu and Mayabunder, both sexes were collected. Earlier *C. biblis andamana* was recorded from andaman.

18. **Ergolis merione merione** Cr.
Common Castor
Not recorded earlier. Specimen collected from Diglipur.

Family ERYCINIDAE

19. **Abisara chela chela** De N.
Spot Judy
Specimen collected from Aerial Bay. Common in North Andaman. Not recorded by Ferrar.

20. **Castalius rosimon alarbus** Fr.
Common Pierrot
Very common throughout Andamans. Collected from Chirria Tapu and Mayabunder.

21. **Jamides celeno blairana** Evans
Common Cerrulean
As described by Ferrar very common throughout Andamans.

22. **Heliophorus epicles indicus** Fruh
Purple Sapphire
Collected at Mayabunder and Interview Island, near a stream. Common. Ferrar had collected it from Middle Andamans in June.

23. **Curetis saronis saronis** M.
Burmese Sunbeam
Common in North and middle Andamans. Specimens collected near streams from Interview Island.

24. **Loxura atymnus prabha** M.
Yamfly
Common. Specimens collected from Middle Andamans.

Family PIERIDAE

25. **Leptosia nina nina** F.
Psyche
Common in February whereas Ferrar collected them in June and December.

26. **Cepora nerissa dapha** M.
Common Gull
Very common in North Andaman. Ferrar writes 'On a brief visit to Tillanchong Nicobars in 1924 I took two DSF females. They may have been stragglers from Burma.'

27. **C. nerissa lichenosa** M.
Common throughout Great Andamans.

28. **Catopsilia crocale pomona** F.
Lemon Emigrant
Common in February-March. Ferrar had collected specimens in October and April and described it as rare.

29. **Gandaca harina andamana** M.
Tree Yellow
Common throughout Andaman Islands.

30. **Eurema blanda silhetana** Wall.
Common throughout Andamans.

31. **Ixias pyrene latifasciata** Butler
Yellow Orange Tip
Common throughout Andaman Islands.

32. **Ixias pyrene andamana** M.
Common throughout Andaman Islands.

33. **Valeria ceylanica naraka** M.
Very common. Collected from Chirria Tapu.

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33. EXTENSION OF RANGE OF THE RIVER-CRAB — *POTAMON (POTAMON) ATKINSONIANUM* WOODMASON (BRACHYURA; CYCLOMETOPA; POTAMONIDAE) — TO POONCH VALLEY (JAMMU AND KASHMIR STATE)

Cyclometopan crabs of the family Potamonidae are permanent inhabitants of freshwaters such as rivers, mountain streams and canals as well as ditches in the lands of the eastern Mediterranean and Asia Minor. Several species of river-crabs of the genus *Potamon* occur in Northern India even at altitudes of about 2100 metres (Alcock 1895-1909, Rathbun 1904-1906, Colosi 1920, Ramakrishna 1950, Serene 1968).

The river-crab — *Potamon* (*Potamon*) *atkinsonianum* Woodmason — is one of the most abundantly found Decapod crustaceans in Poonch Valley. It inhabits shallow rock-pools, rice fields and boulder-streams flanking the course of Poonch River and Betarh Nallah, lurking in the crevices between large, partially submerged boulders and shares its niche with typical mountain-stream teleosts such as *Noemacheilus botia* (Ham.), *Crossocheilus latius* (Ham.), *Garra gotyla gotyla* (Gray) and *Glyptothorax lineatus* (Day), as well as aquatic insects of the genera *Nepa* and *Ranatra*. During the day these crabs leave their shelter and move about actively on dry land, but they do not venture very far from water. There being no previous record of this species of crabs from Jammu and Kashmir State so far, the present report of Potamonid crabs from Poonch Valley is a new record.

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34. CANNIBALISM IN THE GARDEN SNAIL *MACROCHLAMYS INDICA* GODWIN-AUSTEN (STYLOMMATOPHORA: MOLLUSCA)

Macrochlamys indica, a minor agri-horticultural pest, is one of the commoner land snails occurring in India. It is found in abundance in gardens in the rainy season. As a rule, like other land snails, this species is phytophagous in habit (Raut & Ghose 1982) but an unusual feeding on the flesh of their own kind was observed.

In the evening of July 22, 1976, a cloudy day in monsoon, while studying the behaviour of *M. indica* some individuals were accidentally crushed under foot; and within a few minutes a good number of *M. indica* of different size-groups from the adjoining areas crawled towards the crushed snails, and started feeding on their flesh avidly. To ascertain their preference, portions of choice food plants namely the leaves of marigold, bean and lettuce were placed close to the crushed snails but these did not attract the snails till the last bit of flesh was consumed. Subsequent experiments were conducted in the garden and also in the laboratory to determine cannibalism in *M. indica.*

A number of crushed *M. indica* were placed on a brick. The leaves of preferred food-plants were placed around the brick. Within four minutes 38 snails moved to the spot. All of them crawled over the leaves to reach the crushed snails and started feeding on the flesh, and they started eating plant materials only after consuming the flesh.

M. indica were supplied with fresh flesh of the land snails *Achatina fulica, Ariophanta interrupta* and *Rachis bengalensis* but they showed no interest. In another experiment freshly killed *M. indica* and partially decomposed ones were placed side by side. The snails always preferred fresh flesh, though the other form was not spared.

Twenty *M. indica* were released in a terrarium of 30 x 15 x 20 cm on August 10, 1977. The snails were kept active by artificial means but denied food. In the evening of August 16, 16, 4 snails were consumed by the rest of their fellows. Subsequently, 2, 4, 3, 2, 2, and 1 individuals were eaten by other snails on August 17, 18, 19, 20, 21 and 22 respectively. The remaining 2 died on August 24.

Necrophagous habit in pulmonates has been reported by a number of workers (Mitra & Biswas 1974; Moquin-Tandon 1855, Watson 1915, Hyman 1967) but cannibalism in the family Ariophantidae is not on record. Possibly cannibalism or necrophagous habit is innate in pulmonates in general, and it becomes pronounced in the scarcity of the normal plant-food and/or with the easy availability of dead or decomposed flesh, and they do not ordinarily kill their fellows.

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35. TWO NEW COMBINATIONS UNDER *ACACIA NILOTICA* (BENTH.) BRENAN (MIMOSACEAE)

Brenan (1957) has shown that the correct nomenclature of the plant mentioned in Indian Floras as *Acacia arabica* Willd. is *Acacia nilotica* (Linn.) Del. subsp. *indica* (Benth.) Brenan. In this treatment he, however, has not said anything about the two varieties, *Acacia arabica* Willd. var. *cupressiformis* Stewart and *A. arabica* Willd. var. *vediana* Cooke dealt by Cooke in the Flora of Presidency of Bombay. A study of the living and herbarium materials clearly indicate that these two varieties are quite distinct from the plants commonly treated as the typical *A. arabica* Willd. in Indian Floras. Stewart's var. *cupressiformis* has a very peculiar arrangement of the branches giving it a remote resemblance to a *Cupressus* tree and is in this way quite distinct from the typical plants. When these plants grow side by side nobody can miss this very striking difference in appearance. We are of the opinion that this taxon deserves a varietal status under *Acacia nilotica* subsp. *indica.*

With regard to *A. arabica* Willd. var. *vediana* Cooke, Talbot (1909) in the Forest Flora of the Bombay Presidency and Sind, says "This is a distinct variety and may eventually be separated from *arabica* as a species. '*Vedi-babhul*' is distinguished from '*godi-babhul*' or true *A. arabica* by its quicker growth, characteristic fissured bark and by its very different pods which are flat, shortly stalked, 2.5″ x 0.15″ and very little constricted between the seeds. The spines on *vedi-babhul* are also more numerous, stouter and whiter than in the type".

The collection and study of fresh materials from different localities resulted in finding more distinguishing characters in addition to those already mentioned by Talbot. The two taxa can be distinguished as follows:

Bark much fissured, pods flat and with very little constrictions between seeds, inflorescence heads up to 8 with longer peduncles, involucel below the middle of the peduncle (in blossomed heads). ....*A. arabica* var. *vediana*

Bark less fissured, pods moniliform with deep constrictions between the seeds; inflorescence heads up to 6 with shorter peduncle, involucel above the middle of the peduncle (in blossomed heads) ....*A. arabica* (of Indian floras).

Considering the facts put forth by Talbot (1905) and the additional characters observed, we are of the opinion that var. *vediana* Cooke deserves a subspecies rank under *Acacia nilo-*

tica. The two new combinations as discussed earlier are presented here.

Acacia nilotica (Linn.) Del. subsp. **indica** (Benth.) Benan var. **cupressiformis** (Stewart) Vajravelu & Kamble, Comb. nov.

A. arabica Willd. var. *cupressiformis* Stewart, Punjab Pl. 51. 1869; Cooke, Fl. Bombay Pres. Part 3: 444. 1903; 1: 473. 1958 (Repr. ed.); Talbot, For. Fl. Bombay Pres. Sind. 1: 481. 1909.

Local name: Ramkathi, Ramkanti, Ramkantu.

Specimens examined: MAHARASHTRA. *E. Vajravelu* and *S. Y. Kamble* 154077; *S. Y. Kamble* 154082.

Acacia nilotica (Linn.) Del. subsp. **vediana** (Cooke) Vajravelu & Kamble Comb. et Stat. nov.

A. arabica Willd. var. *vediana* Cooke, Fl. Pres. Bombay part 3: 444. 1903; 1: 473. 1958 (repr. ed); Talbot, For. Fl. Bombay Pres. Sind. 1: 481. 1909.

Local name: Vedi babhul.

Specimens examined: MAHARASHTRA: *E. Vajravelu & S. Y. Kamble*, 154076, 154078 & 154079; *K. P. Janardanan* 72751, 66470, 70045, 69004, 76357; *R. Hemadri* 98295, 98024, 83797; *K. V. Billore* 113625, *J. Cheriyan* 109294; *G. S. Puri* 2649, 58438; *R. S. Rao* 71327, 76882, 78934; *S. K. Jain* 8299; *L. D. Garade* 467. GUJARAT: *G. A. Gammie dt.* 18.12.1904. MADHYA PRADESH: *A. S. Rao* 84166, 79232. DIU & DAMAN: *M. Y. Ansari* 94184, *R. S. Rao* 88966.

BOTANICAL SURVEY OF INDIA,
COIMBATORE 641 003.

E. VAJRAVELU

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE,
PUNE 411 001,
December 10, 1980.

S. Y. KAMBLE

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36. TWO INTERESTING PLANT RECORDS FROM MEGHALAYA

(*With two text-figures*)

During the course of botanical explorations in Meghalaya we collected two interesting or otherwise rare plants in certain restricted localities, which were identified as *Stylidium kunthii* Wall. ex DC. (Stylidiaceae) and *Polygala tricholopha* Chodat (Polygalaceae). Reference to literature revealed that *Stylidium kunthii* subsequent to its first report (Fl. Brit. India 3: 420. 1881) has not been collected again from N.E. Region and there are no specimens of this in the Assam herbarium. The present collection (after about 100

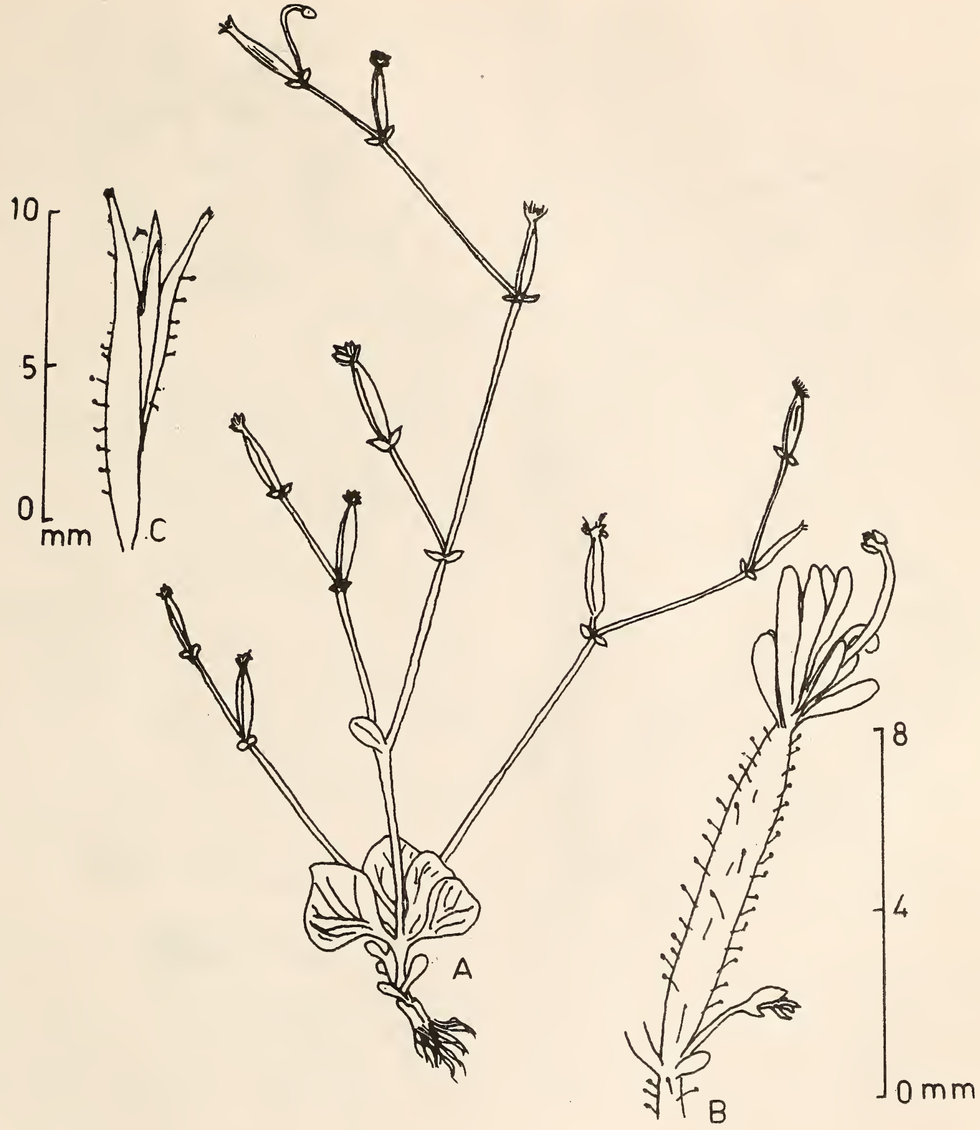

Fig. 1. *Stylidium kunthii* Wall. ex DC.
A Habit; B. flower enlarged; C. dehiscence of capsule.

years) therefore, forms a significant report and is described here.

The other species, *Polygala tricholopha* has also not been reported from this region by Kanjilal *et al.* (1934-40). There is however a solitary, not well preserved sheet in the ASSAM herbarium collected by Kanjilal himself in 1931. But following Bennett. (in Hk. f. Fl.

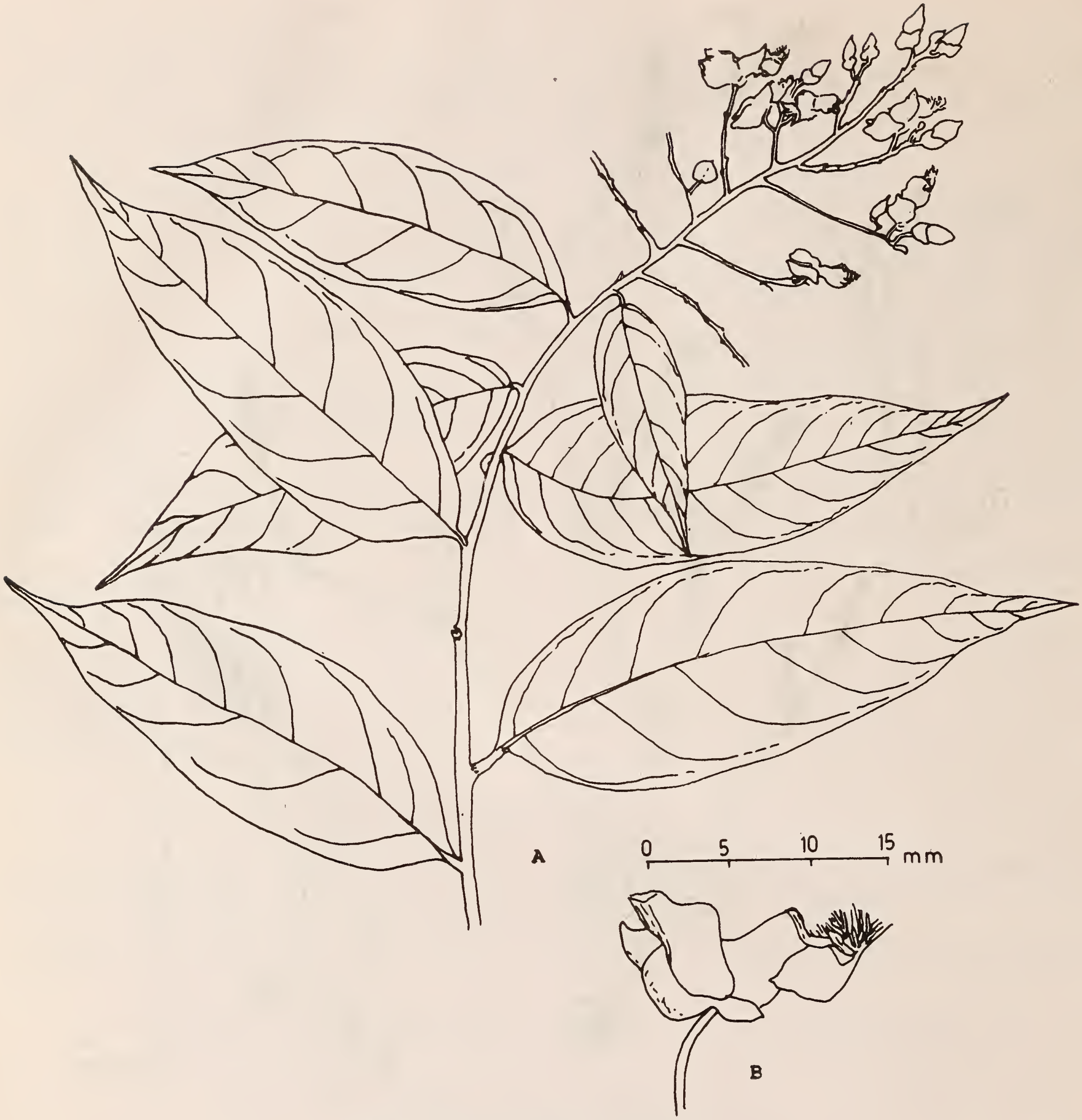

Fig. 2. *Polygala tricholopha* Chodat.
A. Twig; B. flower enlarged.

Brit. India 1: 200) he treats this taxon under *Polygala arillata* Ham. ex Don which is clearly distinct from the present species. Mukherjee (1958) reports *P. tricholopha* from Assam and Meghalaya based on old collection of King deposited in CAL; and also based on Wallichian Catalogue (Wall. Cat. 4191B, in part). This species has not been collected again after 1931 from N.E. region. Therefore, the present collection from Meghalaya forms an interesting report from the area.

Detailed descriptions of these two species and illustrations are provided to facilitate their easy identification.

Stylidium kunthii Wall. ex DC. Prodr. 7: 335. 1839; C. B. Cl. in Hk. f. Fl. Brit. India 3: 420. 1881. (Fig. 1).

Slender, erect herbs, 3-15 cm high; leaves alternate, sessile upper often resulate or falsely whorled, lower ones much smaller, scattered, obovate or orbicular, obtuse, cuneate at base, entire, glabrous, nerves obscure, 0.7-2 x 0.3-1.5 cm; inflorescence of racemose cymes; peduncles usually more than one, dichotomously branched, glandular hairy as are the pedicels; bracts 2, opposite in the forks; flowers white; calyx bilabiate, upper 2-lobed, lower 3-lobed; corolla gamopetalous, irregularly 5-lobed, 4 lobes in 2 pairs and the remaining one smaller and recurved; stamens 2, connate with the style in a column; anther cells confluent; ovary inferior, elongated 2-celled; ovules many in each cell; fruit a capsule, 0.8-1.5 cm, splitting at the apex; seeds minute, brown.

Fls. & Frts.: November-December.

Distribution: Sikkim Himalayas eastwards, Khasi Hills, Bangladesh and Burma.

One of the ephemeral plants commonly associated with *Utricularia bifida*, mosses, etc. along the moist road cuttings in forests.

Specimens examined: Meghalaya: Garo Hills, Mahadeo *Y. Kumar* 5456; Maheshkola *K. Haridasan* 4108 (NEHU).

Polygala tricholopha Chodat in Mem. Soc. Phys. Genev. 31, 2: 98. 1893; Mukherjee in Bull. bot. Soc. Bengal 12: 33. 1958. — *P. hasskarlii* Merr. & Chun. in Sunyatsenia 2: 254. 1934-35. — *Chamaebuxus paniculata* Hassk. in Ann. Mus. Bot. Lugd. Bat. 1: 154, 1863; (Fig. 2).

Climbing shrubs; leaves 5-15 x 2-5 cm, alternate, entire oblong-lanceolate or oblong-elliptic, abruptly acuminate, base rounded, nerves prominent beneath; inflorescence a terminal panicle; flowers pink or pink-purple with an yellow crest, gibbous at base, highly zygomorphic; sepals 5, imbricate, 2 laterals (wing sepals) Purple, larger and recurved in open flowers rest 3 obovate, rounded; petals 3, 2 lateral and the third keeled and crested, crest yellow, multifid, deeply incised stamens 8, united below the middle; anthers oblong; ovary 2-celled; fruit a 2-seeded capsule, ovoid, winged; seeds arillate.

Fls. & Frts.: August-September.

Distribution: Khasi Hills; very rare, collected only once and never again.

Specimens examined: Meghalaya: Khasi Hills — Mawsmai Sacred forest *K. Haridasan* 5959 (NEHU).

We are thankful to Dr. R. S. Raghavan, Regional Botanist at Kew for determining our specimens. Our thanks are also due to the Deputy Director, Botanical Survey of India, Shillong for Herbarium and Library facilities.

DEPT. OF BOTANY,
SCHOOL OF LIFE SCIENCES,
NORTH-EASTERN HILL UNIVERSITY,
SHILLONG 793 014,
November 30, 1980.

K. HARIDASAN
Y. KUMAR
R. R. RAO

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37. A NAME CHANGE FOR *COLEUS VETTIVEROIDES* JACOB (LAMIACEAE)

Loureiro (1790) raised the genus *Coleus* to accommodate the species of *Plectranthus* L'Herit. with the stamens united at base. This character was regarded by Bentham (1832, 1848) as of over-riding importance and thus these two genera came to stay. But this has been a matter of discussion since then. However, Morton (1962), Keng (1978) and Willemse (1979), among others, considered this character as unreliable and therefore the two genera have now been merged, *Plectranthus* L'Herit. (1788) taking precedence. Accordingly the latter two have transferred all the Malayasian and Sri Lankan species of *Coleus* Lour. under *Plectranthus* L'Herit., which incidentally has also covered 7 of the 9 Indian species while another Indian species *C. spicatus* Benth. has been transferred by Wickens (1976). Therefore, the following new combination is proposed for the only remaining Indian species *Coleus vettiveroides* Jacob.

Plectranthus vettiveroides (Jacob) Singh et Sharma *comb. nov.*

Coleus vettiveroides Jacob in J. Bombay nat. Hist. Soc. 42: 320. 1941.

Distribution: INDIA: Tamil Nadu (mostly cultivated). Endemic.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE, PUNE 411 001,
April 8, 1981.

N. P. SINGH
B. D. SHARMA

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38. *CAESALPINIA HYMENOCARPA* (PRAIN) HATTINK, COMB.-NOV. — A SUPERFLUOUS NAME

During the revision of *Caesalpinia* Linn. for 'THE WEALTH OF INDIA: A Dictionary of Indian Raw Materials', the following observations have been made by us regarding the nomenclature of *C. hymenocarpa* (Prain) Hattink *comb. nov*. Since the monographic revision by Hattink (1974) was for 'The Flora Malesiana', the authors felt the urgency for necessary corrections.

The name *C. hymenocarpa,* first published by Wallich (*Cat. List. No.* 5832, 1831), is a *nomen nudum* and hence invalid. Wight and Arnott (1834) mentioned that *C. hymenocarpa* Wall. belongs to *Mezonev(u)ron* Desf., but again this happened to be a *nomen nudum.* Hooker *f.* and Jackson (1895) attributed *M. hymenocarpum* to Wight and Arnott, whereas Hattink attributed it to Jackson (1895) (? Hooker *f.* & Jackson, 1895). This reference also happens to be a *nomen nudum.*

Baker (1878), while working on Leguminosae for THE FLORA OF BRITISH INDIA, mentioned *C. hymenocarpa* Wall., as a synomym, under *M. pubescens* Desf., incidentally validating Wallich's binomial. But, this placement, was wrong, since the plant of Desfontaines is different from *C. hymenocarpa* Wall. Prain (1897) attributed the binomial *Mezoneuron hymenocarpum* to Wight and Arnott and refers to the work of Baker in THE FLORA OF BRITISH INDIA as a synonym (*non* Desf.) along with *C. hymenocarpa* Wall. and *C. glenniei* Thw. Prain distinguished this species from others and discussed their relationships. The quotation of the name of Wallich by Baker, and later Prain quoting the work of Baker (*non* Desf.) in THE FLORA OF BRITISH INDIA as a synonym to the supposed binomial of Wight and Arnott *M. hymenocarpum* validate *C. hymenocarpa* Wall. as well as *M. hymenocarpum* Wt. & Arn. This results in *C. hymenocarpa* Wall. *ex* Baker under *Caesalpinia,* and *M. hymenocarpum* [Wall. (? *ex* Baker)] Wt. & Arn. *ex* Prain under *Mezoneuron;* if Baker's validation is, for any reason, not accepted, the binomial should be *C. hymenocarpa* Wall. *ex* Prain under *Caesalpinia* and *M. hymenocarpum* (Wall. *ex* Prain) Wt. & Arn. *ex* Prain.

These observations, perhaps, escaped the notice of Hattink who made a new combination with Wallich's plant as type and Wallich's original binomial as a base.

In our view, the combination of Hattink happens to be a superfluous name and the details of the taxon shall be as follows:

Caesalpinia hymenocarpa Wall., *Cat. List* No. 5832, 1831, *nomen nudum; ex* Baker *in* Hooker *f. Fl. Brit. India,* 2, 259, 1878.

Mezonev(u)ron pubescens Baker, *loc. cit.; non* Desf.

M. hymenocarpum [Wall. (? *ex* Baker)] Wt. & Arn., *Prod.* 283, 1834, *nomen nudum; ex* Prain, *J. Asiatic Soc. Beng.*, 66, Pt. *ii* (2), 472, 1897; Hooker *f.* & Jackson, *Ind. Kew.*, 2, 223, 1895, *nomen nudum.*

C. hymenocarpa (Prain) Hattink, *Reinwardtia,* 9, 35, 1974.

Thanks are due to Mr Y. R. Chadha, Chief Editor, and Mrs K. Ramachandran, Scientist, Wealth of India, PID, for the facilities provided.

PUBLICATIONS & INFORMATION
DIRECTORATE,
HILLSIDE ROAD,
NEW DELHI 110012,
March 7, 1981.

TENJARLA C. S. SASTRY
G. B. KALE

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PRAIN, D. (1897): Some additional Leguminosae. *J. Asiatic Soc., Beng., 66, Pt ii* (2), 472; *Noviciae Indicae*: Some additional species of Indian plants. West, Newman & Co., London, 1905, 306.

WIGHT, R. & WALKER-ARNOTT, G. A. (1834): Prodromus Florae Peninsulae India, Orientalis. Parbury Allen & Co., London, p. 283.

39. RECORD OF *DATURA FEROX* L. FROM MAHARASHTRA

During plant collections in Akola and Pune districts of Maharashtra an interesting species of *Datura* Linn. was collected, which after critical studies was identified as *D. ferox* L. This plant is a native of China, so far, it has been reported in India from Rajasthan only by Bhandari & Mehta (1980). It is reported here for the first time from Maharashtra. This species can be easily identified from other species of *Datura* L. by its large and very stout unequal spines covering the capsule. This species may possibly occur in other parts of India also, as it might have been erroneously kept under other species. All the specimens examined have been deposited in the herbarium of Western Circle, Botanical Survey of India, Pune (*BSI*).

Its citation, field notes etc. are as follows:

Datura ferox L. Amoen. Acad. 3: 403. 1756; Avery *et al.* in Blakeslee, Genus Datura 21-22 fig. 4. 1959; Haegi, Austr. J. Bot. 24: 415-435. 1976; Bhandari & Mehta in J. Bombay nat. Hist. Soc. 76: 550-551. fig. 5. 1980.

Field notes: An undershrub, upto 1.5 m high, in waste places along with *Abutilon indicum* (L.) Sweet, *Amaranthus spinosus* L., *Cassia tora* L. and *Xanthium strumarium* L. Flowers white. Fruits green drying brown, erect. Seeds many, black.

Specimens examined: MAHARASHTRA: Akola district: Medhshi village, *Kamble* 150101, August 1977; Pune district: Koregaon Park, *Anand Kumar* 66356, December, 1980.

Fls. & Fr.: August-December.

ACKNOWLEDGEMENTS

We thank the Director, Botanical Survey of India, Howrah for facilities and to Dr. B. D. Sharma, Deputy Director, Western Circle, Botanical Survey of India, Pune for encouragement during the course of this work.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE,
PUNE,
February 17, 1981.

S. Y. KAMBLE
ANAND KUMAR
S. G. PRADHAN

40. *HETEROSMILAX POLYANDRA* (LILIACEAE): A RARE ENDEMIC TO INDIA

Heterosmilax Kunth (Liliaceae): Hook. f. in FBI 6: 314 (1894) is a small genus, distinguished from the allied genus *Smilax*, by tubular perianth, corolla tube smooth, stamens-3 with more or less connate filaments. In India, only one species occurs in northern part of W. Bengal, Assam, Arunachal Pradesh, Meghalaya and Manipur.

H. polyandra

Gagnep Bull. Bot. France 71:70 (1934). — *H. indica* A. DC.: *syn. nov.*, T. Koyama, 1/1981 (*Meebold*, CAL 7163).

Climbing slender shrubs, leaves — 3 nerved with rounded base, suberect petiole, rather thin and sharply acuminate. Peduncle-solitary, axillary flattened umbellate with many small flowers, bracteoles — minute, ovate acuminate. Flowers — many obovoid, with male and female. Fruit — small globose, seeds-2 hemispheric.

Specimen examined: West Bengal: *CB Clarke*, 36359, Mongpo 1700 m, (North Bengal). Arunachal Pradesh: *Burkill*, 35913, 37040 (CAL, 1911), Kobo, Abor Expdt. Meghalaya: *G. Gallatly*, 576, 607 (CAL, 1878), Khasia & Jayantia Cherapoonji 320 m. Assam — Gowhati hills, 478299 (CAL, 1853). Monipur — *Meebold*, 7163 (CAL, 1907), Naga Hills 1700 m.

Central National Herbarium,
Botanical Survey of India,
Howrah-711 103,
W. Bengal,
February 3, 1981.

C. R. DAS

41. INTERESTING DISTRIBUTIONAL RECORDS OF FIVE TAXA OF CYPERACEAE

The paper presents new distributional records of five species of Cyperaceae in India. Specimens of these are deposited in Forest Research Institute Herbarium, Dehra Dun (DD.).

Cyperus thomsonii Boeck. in Linnaea 36:294. 1870; Clarke in Hook. f. Fl. Brit. Ind. 6:608. 1893; Kern in Fl. Males. ser. 1, 7 (3): 552. 1974; Siddique & Dixit in Journ. Bombay nat. Hist. Soc. 72(2): 620. 1975.

This species is known from Bengal, Assam and Bihar in India. It has been recently reported from Uttar Pradesh (Siddique & Dixit *l. c.*). A collection (*L. C. Singhai*, 14th Sept. 1953, Saugor) is now a new report of its occurrence from Madhya Pradesh.

Fimbristylis aphylla Steud (in Zoll. Syst. Verz. 1:61. 1854. *nom. nud.*) Syn. Pl. Glum. 2:114. 1855; Som Deva and Naithani in Indian For. 100 (10): 649. 1974-*F. quinquangularis* (Vahl) Kunth var. *crassa* Clarke in Hook. f. Fl. Brit. Ind. 6:644. 1893.

It is distributed in Tamilnadu and Karnataka. Recently (Som Deva & Naithani *l. c.*) reported its occurrence from Dehra Dun district of Uttar Pradesh. A collection (*O. P. Sharma*, Dec. 1957. East Punjab) indicates its occurrence in Punjab.

Fimbristylis insignis Thwaits Enum. Pl. Zeyl. 349. 1864; Clarke in Hook f. Fl. Brit. Ind. 6:645. 1893; Kern in Fl. Males. ser. 1, 7 (3): 555. 1974.

From India this species is known only from Tamilnadu. An old collection (*J. S. Gamble*, 4513 (A), 4th July 1877, near Simla in Himachal Pradesh) is now a new record for North India.

Fimbristylis salbundia (Nees) Kunth En. 2 : 230. 1837; Clarke in Hook f. Fl. Brit. Ind. 6: 643. 1893; Kern in Fl. Males. ser 1, 7 (3): 553. 1974. *Trichelostylis salbundia* Nees in Wight. Contr. 105. 1834.

It is known from Bengal, Assam and Madhya Pradesh. An old collection (*Brandis* 3321, Aug. 1864, Kulu) indicates its occurrence in Himachal Pradesh.

Fimbristylis yunnanensis Clarke in Jour. Linn. Soc. Bot. 36: 247. 1903; Kern in Blumea 10 (2): 648. f. 3. J-S. 1960.

Kern in Fl. Males. ser 1, 7 (3): 591. 1974 has mentioned its occurrence from North India without giving any locality. A collection (*Bor* 638, Year 1936, Naga Hills) indicate its occurrence in Eastern India from Naga Land.

New Forest,
Dehra Dun 248 006,
February 4, 1981.

H. B. NAITHANI

42. THE RARE AND THREATENED FERN *ADIANTUM SOBOLIFERUM* WALL. EX HOOK. — A NEW FIND FOR EASTERN INDIA

During the course of revisionary study of the genus *Adiantum*, I examined a few specimens from Eastern India representing *Adiatum soboliferum*. Scrutiny of literature revealed that *A. soboliferum* Wall. ex Hk. was first known from Ava in Burma. Later Beddome (1883) reported its occurrence from Travancore mountains in South India. Its occurrence in Eastern India, and non collection of the plants after 1901 upto date by the Regional circles of the Survey at Shillong and Coimbatore may indicate the endangered nature of the species.

A. soboliferum is closely allied to *A. lunulatum* Burm. f. — a well known, widely distributed species in India. As such a key to distinguish the two species is provided for easy identification.

Key to species

Stipes, rachis, stalks of the pinnae winged, not glossy, Texture of pinnae sub-membranaceous... .... *A. soboliferum*

Stipes, rachis, stalks of the pinnae not winged, but glossy, Texture of pinnae membranaceous... .... *A. lunulatum*

Adiantum soboliferum Wall. ex. Hook. Sp. Fil. 2: 13, t. 74A. 1851; Bedd., Ferns Brit. India t. 19. 1866; Christensen, Index Fil. 33, 1906, Holttum, Ferns Malaya 2: 598, 1954. *A. mettenii* Kuhn ex Hook. et Bak., Syn. Fil. ed. 2. 472. 1874; Christensen Index Fil. 30. 1906.

A. caudatum var. *soboliferum* Bedd., Handb. 84, 1883.

A. lunulatum var. *mettenii* Bedd., Handb. 83, t. 83. 1883 et suppl. 17. 1892.

Rhizome erect, bearing tuft of fronds, scaly, scales lanceolate, brown, margin entire. Stipe black, scaly at base, smooth above, winged throughout, rachis black winged with a lateral wing of 5 mm wide, wing of stipe and rachis plain. Lamina lanceolate, simple pinnate, terminated by deltoid apical pinnae. Lateral pinnae stalked, sub-dimidiate, glabrous, stalk of pinnae winged, wing of stalk some what crisped. Lowest pinnae broader, less crescent shaped, outer edge of pinnae lobed to depth of equal to about $\frac{1}{4}$ of width of pinnae, sterile lobe often denticulate, texture sub-membranaceous, veins free, dichotomously branched, raised on the upper surface, grooved on upper surface, lobes soriferous bearing reflexed soral flaps. Spores tetra-hedral brown.

Specimens Examined:

Zamka, 150 m, Nagahills, *H. Collect* 16 (July 7th, 1882), Sumding, Assam, *N. Gill* 115 (Feb. 24th, 1901).

ACKNOWLEDGEMENT

I am grateful to Dr. J. N. Vohra, Regional Botanist, (Cryptogams), Cryptogamic Section, Headquarters, Botanical Survey of India for encouragement.

BOTANICAL SURVEY OF INDIA,
HOWRAH,
February 11, 1981.

S. R. GHOSH

43. ON THE OCCURRENCE OF *SELAGINELLA TAMARSCINA* (P. BEAUV.) SPRING VAR. *PULVINATA* (WALL. EX HOOK. ET GREV.) ALSTON IN INDIA AND BURMA

Alston (1945) reported the occurrence of *Selaginella tamarscina* var. *pulvinata* (wall. ex Hook. et Grev.) Alston, in India (Kumaon and Assam) based on two herbarium specimens in the Kew Herbarium (Wall. cat. no. 7087 from Kumaon, collected by Robert Blinkworth, and anonymous *s. n.* from Assam), but remarked that "this species has not been collected in India in recent years and it is possible that existing specimens have been so labelled in error....". Also, he held that its reported occurrence from Burma (Mason, 1883) is doubtful, as no herbarium vouchers are available. A duplicate of Wall. Num. List No. 7087 is available in the Central National Herbarium, Howrah, but it bears no mention of the locality of collection. No other specimen of this taxon is available in any Indian herbaria, nor has it been collected during the extensive exploration of Kumaon and Assam areas undertaken by the Forest Research Institute, Dehra Dun, as well as the Botanical Survey of India, for the past 25 years. This confirms Alston's surmise that Wall. Num. List. No. 7087 is perhaps not from India. Similarly the other specimen in Kew Herbarium, reportedly collected from Assam, is also from source other than India. *S. tamarscina* var. *pulvinata*, thus, does not occur in India.

As regards its occurrence in Burma, Mason (1883), while reporting it remarked that "the specimen being unmanageable could not be placed among other species and is finally lost". This accounts for the absence of herbarium vouchers noted by Alston. The Industrial Section of the Indian Museum, Calcutta, however, has in its collection a specimen of *S. tamarscina* var. *pulvinata* collected by the Reporter on Economic Products from Mandalay in 1908 (Accession no. 41904). This confirms the occurrence of this taxon in Burma.

ACKNOWLEDGEMENTS

I am thankful to Dr. A. S. Rao, Joint Director, Botanical Survey of India and Prof. B. K. Nayar, University of Calicut, Calicut for going through the manuscript and helpful suggestions.

BOTANICAL SURVEY OF INDIA,
ALLAHABAD,
September 1, 1980.

R. D. DIXIT

REFERENCES

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MINUTES OF THE EXTRAORDINARY GENERAL BODY MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY

In requisition to a request made by 13 members in accordance with rule 29, an Extraordinary General Body Meeting of the Society was held on Wednesday, the 29th September 1982 at 6.30 p.m. at Coomaraswamy Hall in the Prince of Wales Museum when the following were present:

1. Mr Mahesh N. Sanzgiri
2. Mr Nitin Jamdar
3. Mr S. G. Monga
4. Mr Oswald Thayil
5. Mr Sudip D. Bhaumik
6. Mr Rishad Naoroji
7. Mrs Parveen Sisodia
8. Mr Hasan Tyabji
9. Mr J. P. Irani
10. Mr Bansi Mehta
11. Mrs Panna Raiji
12. Mr V. N. Raiji
13. Mr N. M. Mulla
14. Mr Naresh Dutt
15. Mr K. D. Gokhale
16. Mr Vasant Gandhi
17. Mr R. S. Moral
18. Mr A. D. Kunte
19. Mr S. N. Mistry
20. Mr Y. K. Nagrath
21. Mr P. R. Cama
22. Mr Jimmy Ollia
23. Mr R. E. Hawkins
24. Mr N. D. Mulla
25. Mr S. T. Tambe
26. Mr D. N. Goenka
27. Miss Heta Pandit
28. Mr A. K. Joshee
29. Dr A.N.D. Nanavati
30. Mr D. J. Panday (In the Chair)
31. Mr Narayan Chhatbar
32. Mr Sidney D'Souza
33. Mr K. N. Naoroji
34. Mr Anil Dave
35. Mr D. S. Gaitonde
36. Miss S. G. Khadilkar
37. Dr P. J. Deoras
38. Mr Humayun Abdulali
39. Mr J. B. Dordi
40. Mr R. Holkar
41. Dr R. M. Naik
42. Mrs P. Mukherjee
43. Mr Parvish Pandya
44. Mr Premchand Dabrai
45. Mr M. R. Almeida
46. Mr Dilip Patil
47. Miss Arati Kaikini
48. Mr Farhan Thakur
49. Mr M. D. Agharkar
50. Mr Ulhas Rane
51. Mr A. G. Nawalkar
52. Mr K. K. Vajifdar
53. Mr A. G. Puranik
54. Mr Shashikumar Menon
55. Mr H. K. Divekar
56. Miss M. M. Haribal
57. Mr S. R. Nayak
58. Mr A.J.T. Johnsingh
59. Mrs S. M. Kothari
60. Miss Raina Potnis
61. Miss Nafisa Khapra
62. Mr J. C. Daniel
63. Miss Saber S. Driver
64. Mr S. A. Ruparel
65. Mr Vijay Porecha
66. Mr A. G. Patwardhan

67. Mr Amir J. Ali
68. Mr Ram V. Jethmalani
69. Dr E. Sequeira
70. Dr Bipin Chandriani
71. Mr Ghansham L. Kalro
72. Mr S. P. Bavdekar
73. Mr V. James
74. Dr S. R. Amladi
75. Mr R. Sahgal
76. Mr Bittu Sahgal
77. Mr Kiran Srivastava
78. Mr G. C. Patel
79. Mr A. V. Ghangurde
80. Mr P. C. Gandhi
81. Mr Firoze Mistry
82. Dr C. V. Kulkarni
83. Dr Sálim Ali

Dr Salim Ali, the President of the Society, requested Mr. D. J. Panday, the Vice-President to take the Chair and conduct the meeting.

Mr. D. J. Panday thanked the President and began with an apology for the delay of half an hour in commencing the meeting owing to a mistake in the timing announced in the papers.

The meeting had been called in response to a requisition by several members to question the proposal for the BNHS establishing an Institute of Ornithology and Natural History with funding and support from the Government of India and either to approve or oppose the move. The Chairman therefore requested the Honorary Secretary to give a resume of the proposal and its background.

The Honorary Secretary, Dr. A. N. D. Nanavati, explained that in the past paucity of funds had prevented the Society from being as active as it should be in field research. The current research projects with temporary financial assistance from outside agencies had to some extent remedied the shortcoming. But the fundings for the projects were for limited periods at the end of which they would have to be wound up leaving such scientific work incomplete. More importantly the enormous investment made in training workers in techniques of field research would be lost. It is therefore essential to find ways and means to support our scientific work and employment of our research scientists on a continuing basis.

Dr Nanavati went on to say that when discussing this problem with the Department of Environment we were informed that the Department was funding elsewhere an Institute of Ecology and an Institute of Wildlife Studies. They therefore did not wish to support another institute of the same type but would be prepared to support an Institute of Ornithology at the BNHS as they felt that our main strength was in this field. The Department further indicated that there would be no objection to the BNHS raising independent funds for an allied Institute of Natural History.

During the prolonged exchange of views by a large number of persons the Chairman had to urge members several times to be brief and confine discussion to matters raised in the requisition for the meeting. He had to rule out of order remarks bearing on extraneous issues and on personalities.

Several members both in favour of and opposed to the proposal raised a number of questions seeking clarification of certain issues. Most of the queries were answered as fully as it was possible to do so within the limited time available.

In response to inquiries how the Society was being financed by Government grants and the extent of control by such financing bodies, the Honorary Treasurer, Dr C. V. Kulkarni, stated that in addition to a small grant by the Government of India for the *Journal*, the Society since 1958 was receiving from the Government of Maharashtra Rs. 65,000 per year, for the maintenance of the collection, but this year it was raised to Rs. 1,20,000 and next year it would be Rs. 1,25,000. These grants cover salaries of collection maintenance staff and the maintenance of the building. It was pointed out that grants recently received from the Centre and the State for repairs of Hornbill House and the charges collected for the working of the Society's projects have saved it from financial loss.

Regarding Government control a representative of the Department of Science and Technology was appointed as an ex-officio member of the Executive Committee. But there is no interference by Government in the working of the Society.

In answer to an inquiry by Mr Agharkar about the actual assets of the Society, the Honorary Secretary stated that assets completely owned by the Society were its Library and its records. Under an agreement between the Government, the Museum and the Society made about 20 years ago when the Society was being moved into Hornbill House, the Society had no absolute ownership or control over the collection. At this stage Mr Humayun Abdulali stated that he was one of the signatories of the agreement and disagreed with the statement just made. Dr. Nanavati then read out the relevant clauses of the agreement in support of what he had said. The clauses of the agreement are recorded as follows:

i) a representative of the Ministry of Scientific Research and Cultural Affairs will be a member of the governing body of the Bombay Natural History Society;

ii) the Bombay Natural History Society will make its collections available to the Zoological Survey of India, Calcutta, for purpose of research and reference;

iii) the Bombay Natural History Society will not sell, donate or give in exchange or otherwise dispose of to any person or body its collections without the prior approval of the Government of India. If at any time the Society decided to dispose of any collections, these shall first be offered to the Zoological Survey of India;

iv) if at any time the Bombay Natural History Society ceases to exist its collections will become the property of the Zoological Survey of India.

In reply to a query whether an agreement had already been reached with the Government regarding the proposed Institute it was explained that the Society had been asked to put up a proposal. If Government were interested it would appoint a Committee to discuss the terms and conditions for the scheme. The final decision would be taken by the BNHS Executive Committee after satisfying itself about reasonable safeguards for preserving the integrity and interests of the Society and its control over the new Institution and its staffing.

Among members who expressed views generally critical of the proposal in its present form were: Mr Humayun Abdulali, Mrs Phillippa Mukherjee, Dr Deoras, Mr Narayan Chatbar, Dr A. K. Joshi, Mr Ulhas Rane, Mr K. N. Naoroji, Mr Debi Goenka, Mr Parvesh Pandya, Mr Kiran Gokhale. Opinions expressed ranged from an outright rejection of the idea to conditional support of the proposal with changes both in its content and in the mode of preparation of the proposal and presentation to Government. The opinion for rejection was based on the apprehension that a large Government controlled scientific institute fostered by the BNHS would swamp the independent status of the parent body and would be to the detriment of the amateur activities of its members and their interest in its assets, i.e. the library and collections. Moreover the new Institution would increase the work of the existing staff and cause neglect of their routine duties and services to members over which shortcomings there are already complaints. Some members said that though they would favour a large Institute, the Society did not have the managerial talent for running a big project which should be kept completely separate from the Society. The Society could only act as a catalyst for setting it up and be associated with it in a consultative capacity. Most members however did not oppose the formation of the Institute but demanded assurances on several heads against any association between the BNHS and the Institute which should be detrimental to the former, namely the extent of Government representation on the governing body, the sort of participation by amateur members in the activities of the new Institution, the parity of salaries between the Society's and the Institute's staff etc. Reference was also made to the President's letter in *Hornbill* of 1977. For this purpose it was sought that the Executive Committee should not be allowed to forward the proposal without rediscussing and redrafting it in consultation with the General Body. The arguments were crystalized in a resolution subsequently introduced by Mr Ulhas Rane.

Mr M. D. Agharkar, Dr C. V. Kulkarni, Dr R. M. Naik, Dr A.N.D. Nanavati, Mr Bansi Mehta, Mr J. C. Daniel, Mr H. K. Divekar, Mr Ratansinh Moral, Mr Bittu Sahgal, Mr Dayanand Gaitonde spoke in support of the proposal for establishing the Institute of Ornithology and Natural History. It was explained that the apprehension expressed by members about the new Institute was unrealistic. The Society should go ahead with the formation of the new Institute and during negotiations ensure against the Society losing control over the Institute and over its own affairs. There was no question of change in the status of the Society's library and collection which would continue to be lodged at Hornbill House and available for use of members as at present. Amateur interest in Natural History was always being fostered by the Society. Members have participated in certain scientific programmes, but amateurs could only devote part-time attention to these programmes which could only be conduct of by a staff of full time workers. The proposed Institute could initiate a number of necessary study projects on a proper continuing basis in Ornithology and other allied branches of Natural History without which Ornithology in isolation could not be adequately studied. Interested members could be given encouragement for participating in the new facilities created by the Institute. Staffing of the Institute would be under the control of the BNHS and staff salaries would have to be on a par in the same organization. It was pointed out that the Society has a national commitment gathered over the last 100 years which it has to exploit. We should independently raise funds by having, for example, a walk-in aviary at the new Institute. Members supporting the proposal were emphatic in stating that the proposal should be processed by the Executive Committee which had been elected by and represented the General Body of the BNHS and was the proper channel for negotiation with the funding authority.

Finally the following Resolutions were inintroduced:

1. *By Mr. M. D. Agharkar, seconded by Dr. S. R. Amladi*: RESOLVED that the General Body desired that the Executive Committee should make all efforts to obtain funds from Government and establish the Institute of Ornithology as proposed.

1. a. *An amendment to the above Reso-*

lution was proposed by Dr Deoras, seconded by Dr A. K. Joshi: RESOLVED that any proposal to be finalized to have an institute of ornithology under the Bombay Natural History Society be first discussed by the General Body of the Bombay Natural History Society and published in the *Hornbill* before being sent up to Government.

2. *By Mr Ulhas Rane, seconded by Mr K. N. Naoroji*: RESOLVED that no commitment be made on the proposal in its present form of setting up an Institute of Ornithology at/under the BNHS. RESOLVED further that whilst the offer of funds for setting up an Institute of Ornithology or an Institute of Natural History be kept open and live, the actual mechanics of how to implement the setting up of the above institute should be given more thought, such that the existence of the Society, i.e. the BNHS or its amateur status or its independence of thought, policy and action is not jeopardized; that to this end a further meeting and dialogue with members be arranged within a reasonable period of 90 days or at a suitable time to discuss alternative methods for setting up of the proposed institute.

The Resolution of Mr Ulhas Rane, representing the views of the signatories of the requisition was, first put to vote. There were 24 votes in favour and 34 votes against, the resolution being defeated.

Dr Deoras's amendment to Mr M. D. Agharkar's resolution was then voted on and was lost, 25 voting in favour of it and 34 against.

Mr M. D. Agharkar's resolution was then voted on and was passed by 36 votes in favour of it and 28 against.

The meeting terminated with a vote of thanks to the Chair.

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1981-82

EXECUTIVE COMMITTEE

President

Dr. Sálim Ali, D.SC., F.N.A.

Vice-Presidents

Mr. R. E. Hawkins
Mr. G. V. Bedekar, I.C.S. (Retd.)
Mr. D. J. Panday

Member

Director, Dept. of Science &
Technology, Government of India.

Ex-Officio

Elected Members

Mr. Humayun Abdulali
Dr. S. R. Amladi, M.D.
Prof. P. V. Bole
Mr. Divyabhanusinh Chawda
Dr. B. Dasgupta
Mr. H. K. Divekar
Mr. David Fernandes
Dr. C. V. Kulkarni, M.SC., PH.D. (*Honorary Treasurer*)
Mr. Bansi Mehta
Mrs. Phillippa H. Mukherjee
Dr. A. N. D. Nanavati, M.D. (*Honorary Secretary*)
Mrs. Dilnavaz Variava

ADVISORY COMMITTEE

Mr. H. G. Acharya	*Ahmedabad*
Mr. F. C. Badhwar O.B.E.	*New Delhi*
Dr. B. Biswas	*Calcutta*
Mr. S. Chaudhuri	*New Delhi*
Dr. Madhav Gadgil	*Bangalore*
Mr. N. D. Jayal	*New Delhi*
Mr. Shivarajkumar Khachar	*Jasdan*
Mr. Lavkumar Khacher	*Rajkot*
Mr. M. Krishnan	*Madras*
Mr. Duleep Matthai	*New Delhi*

HONORARY SECRETARY'S REPORT FOR THE YEAR 1981
98TH ANNUAL REPORT

MEMBERSHIP

The Executive Committee is pleased to report that for the first time in many years the number of ordinary members crossed the 1000 mark during the year under review.

While this is a matter of some satisfaction, it does not in any way meet the needs of the Society. On current rates of income and expenditure we should have an additional 5000 ordinary members if we are to meet our membership commitments from membership subscriptions.

We repeat our appeal to members to recruit more members, particularly Compound Corporate Members, a field of recruitment in which we have done poorly indeed. The total recruitment at the end of the year was 37 in a target of 1000. The Compound Corporate Membership fee of Rs. 1500/- offers the Society's facilities to company members for a period of 25 years. I hope members employed or involved in management or owning progressive companies will enroll them as members and provide the Society with a sound financial base.

Details of membership for the past quinquennium, showing members fully paid up on 31st December of each year are given in the statement below:

	1978	1979	1980	1981	1982
Ordinary members	541	640	660	764	1044
Corporate members	180	184	180	168	176
Life members	257	274	305	327	349
Compound Corporate members	2	9	9	20	37
Student members	39	96	83	94	165
Honorary members	4	4	4	3	3
Forest Department nominees	—	—	—	—	—
	1023	1207	1241	1376	1774

Members elected in 1981, but not paid	28
Members paid for 1980, but not paid for 1981	104

PUBLICATIONS

Journal:

Five issues of the Journal were published during the year under review and we were finally successful in our efforts to publish the journal on time. The August and December issues for the year were published during those months.

The journals published in 1981 included the August & December issues for 1980 Vol. 77

(2 & 3) and Vol. 78 for 1981. The 1031 pages of the journal published during the year continued to present authoritative data on the natural history of the oriental region.

Hornbill:

The Hornbill now in its 5th volume continued to maintain its popular appeal to members and we are glad to report that it has become one of the reasons for attracting and retaining members on the Society's membership rolls. We again remind members that it will be difficult to maintain its popular appeal without support from members in the form of articles and photographs. We thank the Seth Purshotamdas Thakurdas Devaliba Charitable Trust for generous financial assistance for the publication of the Hornbill.

BOOKS

Our popular publications the BOOK OF INDIAN BIRDS by Salim Ali and the BOOK OF INDIAN ANIMALS by S. H. Prater continued to have good sales as is evident from the sales statement given below. However considering their value these publications could sell better with more publicity.

Books under preparation:

GRASSES OF WESTERN INDIA

By T. Hodd (1st edition):

The fully illustrated, handy, field guide for the identification of Grasses of Western India will be available in 1982.

A SYNOPSIS OF THE BIRDS OF INDIA & PAKISTAN

By Dillon Ripley (2nd edition):

The printing of this definitive work on bird taxonomy of the Indian region was completed during the year and copies will be available in 1982.

SOME BEAUTIFUL INDIAN CLIMBERS & SHRUBS

By Bor & Raizada (2nd edition):

This excellent ready reference on the wild and cultivated shrubs and climbers occurring in India will be published in 1982.

	Sales in		Balance stock
	1980	1981	31-12-1981
The Book of Indian Birds	2197	1389	5582
The Book of Indian Animals	1007	1392	2510
Some Beautiful Indian Trees	264	234	1988
Glimpses of Nature in India Booklet	353	192	1608
Checklist of the Birds of Maharashtra (1st edition)	102	106	
Checklist of the Birds of Maharashtra (2nd edition)	—	81	1890
Checklist of the Birds of Delhi, Agra & Bharatpur	54	89	185

ENCYCLOPEDIA OF INDIAN NATURAL HISTORY

Centenary Publication 1883-1983:

It is hoped that the Encyclopedia when ready will provide a ready reference volume for students in schools and colleges and to the general readers on the natural history of the Indian region.

A CENTURY OF NATURAL HISTORY,

Centenary Publication 1883-1983:

A book of selected articles of natural history interest covering general natural history, expeditions and explorations, hunting, fishing, conservation, wildlife photography, mammals, birds, reptiles, fishes, insects, other invertebrates and botany from the Society's journal published during the hundred years of its existence. The selection has been completed and the book will be available in the Centenary year.

CONSERVATION

The Society is recognised by the Central and State Governments in India and by International Organisations abroad as an authoritative source for information on conservation of wildlife and natural resources. This recognition is expressed in the form of association of its officials with State and Central Wildlife Advisory Boards and representation on the Specialist Groups of the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources.

As the Western Regional Representative of the Indian Board for Wildlife, the Curator, is a member of the State Wildlife Board of Rajasthan, Maharashtra, Madhya Pradesh and Goa.

The Curator was a member during the year of the following committees of the Central Government and other organisations concerned with conservation:

(a) Expert Committee for Management Guidelines for National Parks, Government of India
(b) University Grants Commission on Wildlife Studies
(c) Pine Plantation in Bastar Enquiry Committee, Government of India
(d) Goa Afforestation and Natural Resources Committee of the Planning Commission.

SEMINARS & CONFERENCES

The Curator attended the meeting of the Species Survival Commission at New Delhi in February 1981 and the meeting of the Convention on International Trade in Endangered Species at New Delhi in February.

Mr. V. C. Ambedkar represented the Society at Bird Watchers' Camp at Lonavla, Maharashtra.

MEMBERS' ACTIVITIES

Sikkim survey:

An application was made to the Dorabji Tata Trust for financial assistance for Mr. Ulhas Rane and other members of the Society for a field survey to Sikkim to study birds, butterflies, and the botany of the area.

Bird counts:

The monthly roadside count of birds at the Borivli National Park on the last Sunday of each month was continued. Apart from the collection of data to record the fluctuations in the bird fauna the main aim is to introduce members to bird watching.

Nature walks:

Nature walks were held in various areas of natural history interest around Bombay for bird watching, vegetation study and general natural history. The programme helped in recruiting new members and fostering interest in natural history among members.

Nature camp:

A nature camp was organised at Pachmarhi, Madhya Pradesh, from 8th October to 20th October 1981 and 85 members participated (in three batches). Members also prepared list of birds, butterflies and a list of the plants seen and studied during the camp.

RESEARCH AND OTHER ACTIVITIES FUNDED FROM FIELD WORK FUNDS

The field work funds available at the Society supported the following activities:

Salim Ali — Loke Wan Tho Ornithological Research Fund:

Mrs. K. R. Lalitha studied 'Comparative Ecology of Drongos, with special reference to Ecological Isolation among them', and Mr. Shahid Ali on 'the ecology of Grey Partridge' at Point Calimere.

Financial assistance was extended to Mr. Koneri Rao, a member of the Society, to study the Yellow-headed Bulbul in the Gingee area of Tamil Nadu.

Salim Ali Nature Conservation Fund:

(a) A study of the disappearing bamboo stock in Tamil Nadu and its socio-ecological impact — by Ramesh Bhat. The study examined the status of bamboo forests in certain selected areas of Tamil Nadu and regeneration of bamboo resources.

(b) Ecological studies on the Lions of the Gir Forest: by S. P. Sinha. Assistance was extended to Mr. S. P. Sinha to commence monitoring the possible progressive changes of the food and food habits of the lion with reference to environmental conditions.

In addition the fund subsidised the publication of the Hornbill and purchase of books for the library.

Pirojsha Godrej Fund:

Conservation Education — Assistance was given from the fund for the Wildlife Exhibition at Patkar College and Ruparel College under the auspices of the Nature Education Scheme of the Society.

RESEARCH FUNDED BY GOVERNMENT & GOVERNMENTAL AGENCIES

Studies on the movement & population structure of Indian avifauna:

A field research station was established at Point Calimere. Operations at Point Calimere laid emphasis on netting, trapping and ringing of birds. At Point Calimere baseline data on weather, botany, entomology, marine biology and other factors such as mammals and reptiles were collected comprehensively.

A total of 45,378 birds belonging to 277 species were ringed and released in all the four stations worked by the project.

Data on plumage, age, physical measurement, habitat preference etc. were recorded.

The capture/recapture trends both at Point Calimere and Bharatpur indicate that several resident and migrant birds tend to remain in/revisit the same ecological regimes. This suggests that netting/ringing causes very little disturbance to wintering/resident species in these areas.

Station	Duration	Species	Total
Point Calimere	July 1980 to June 1981	153 (19 exclusive)	26040
Bharatpur	November 1980 to April 1981 (166 days)	127 52) exclusive)	15535
Chilka	February 1981 March 1981 (55 days)	52 (13 exclusive)	2158
Harike	December 1980 March 1981 (80 days)	58 (29 exclusive)	1645
	Total	277	45378

An ecological study of Bird Hazards at Indian Aerodromes:

The years programme of work at two airports in the country with the specific aim of identifying all birds species potentially hazardous to aircraft and the habits of these birds their ecological requirements and methods of discouraging problem birds from the vicinity of aerodromes was completed.

The report giving details of work and recommendations resulting from the study was sent to the Aeronautics Research and Development Board. A more detailed study has now been approved. This study will spread over a period of 4 years and will cover 20 airfields in various parts of the country.

Hydrobiological (Ecological) Research Station at Keoladeo Ghana Bird Sanctuary:

This project to study the ecology of the water bird species at the Ghana Bird Sanctuary and the ecology of the Bharatpur Sanctuary in relation to its bird fauna commenced operation. Dr. V. S. Vijayan, formerly Wildlife Biologist at the Kerala Forest Research Institute and a former student of Dr. Salim Ali took over as Project Scientist. The laboratory has now been established at Bharatpur and data collection started on a regular programmed basis.

Ecology of Certain Endangered Species of Wildlife and their Habitats:

Financial assistance for this project which aims at studying the ecology of the Great Indian Bustard and Indian Elephant as a beginning was received during the year and work was commenced on the Great Indian Bustard. Two field stations were established, one at Solapur, Maharashtra and one at Karera, Madhya Pradesh. Data on the breeding season at Solapur was collected during the year.

DONATIONS

For Salim Ali Nature Conservation Fund:

1.	Dr. Sálim Ali	Rs.	7500.00
2.	Cheng Kim Loke Foundation, Singapore	Rs.	180873.14
3.	Darbar Shri Alakhachar Public Charitable Trust, Jasdan	Rs.	4000.00
4.	M/s N. S. Gazdar & Co. Pvt. Ltd. (for Save Silent Valley Campaign)	Rs.	2500.00
5.	M/s Airfreight Pvt. Ltd. (for Save Silent Valley Campaign)	Rs.	2500.00

For Charles McCann Vertebrate Zoology Field Work Fund:

6.	Mr. S. Chaudhuri	Rs.	600.00
7.	Mr. A. A. Faizee	Rs.	175.00

For Sálim Ali — Loke Wan Tho Ornithological Research Fund:

8.	Sir Dorabji Tata Trust	Rs.	50000.00

For Hospitality Fund:

9.	Dr. Sálim Ali	Rs.	1000.00

For Publications Fund:

10.	Dr. Sálim Ali	Rs.	6500.00

For Life Membership Fund:

11.	Mr. K. M. Khareghat	Rs.	2500.00
12.	Mr. R. E. Hawkins	Rs.	1000.00

For General Fund:

13.	Mr. Bill Harvey	Rs.	525.00
14.	Mrs. S. R. Grubh	Rs.	250.00
15.	Prof. P. R. Pisharoty	Rs.	300.00
16.	Mr. Usha Kumar	Rs.	500.00
17.	Grindlays Bank, Bombay	Rs.	1000.00

REFERENCE COLLECTION

During the year under reference 122 specimens were registered into the collections.

Mammals	1
Birds	92
Reptiles	15
Amphibians	14
	122

Among these the following species of birds were additions to the collections.

1. *Sterna fuscata*
2. *Eurynorhynchus pygmaeus*

NATURE EDUCATION SCHEME

Students from 84 schools participated in various activities of the Scheme. Besides school students, 108 trainee teachers and 85 college students, took advantage of our programmes. In addition this year 9 new schools from Thane participated.

Field trips:

A total of 970 students from 34 schools were taken on field trips.

A camp for Municipal School children was organised by the National Sponsorship Council at the S.N.D.T. College. A series of lectures illustrated with slides were arranged as well as film shows on wildlife. The students were taken to Victoria Gardens on a field trip and also guided in the preparation of projects on different topics such as migration of birds, resident birds, reptiles, mammals and common trees.

A Gulmohur camp for Municipal School children from Bandra was organised by the Society for Clean Cities, Children's Complex, Bandra. Slides and films on wildlife were shown, and talks on natural history given.

Material for 2 nature booklets on insects was completed. Matter for the 3rd booklet on reptiles and amphibians is ready.

MEETINGS

January, 25:	*Nature Walk*: Kanheri Caves.
February, 1:	*Nature Walk*: Sasunavagarh.
„ ,4:	*Slide show*: Fauna & Flora of Sikkim by Miss Meena Haribal.
March, 21-22:	*Nature Camp*: Murud Janjira.
April, 12:	*Nature Walk*: Kakuli Lake.
„ ,27-29:	*Film Show*: 1. Devil Birds; 2. Marshes of Bharatpur; 3. Safari by Balloon.

June, 13-14: *Nature camp*:
Matheran.
July, 3: *Film Show*:
1. Crocodiles;
2. Great Barrier Reef.
„ , 12: Tree Planting.
September, 5: *Nature Walk*:
Chinchota Falls.
„ , 11: *Film Show*:
1. Language of Birds;
2. Elsa the Lioness.
October, 31: *Slide Show*:
By Dr. Ralph Schreiber, Natural History Museum,
Los Angeles County.
Nov., 29: *Nature Walk*:
Palasdari Lake.
Dec., 16: *Slide Show*:
By Mr. Hanumantha Rao.
„ , 25-27: *Nature Camp*:
Koynanagar.

REVENUE & ACCOUNTS

The financial situation of the Society has improved. After many years of deficit, the year's working showed a small surplus.

STAFF

The Committee wishes to record its appreciation of the willing cooperation of the staff in the activities of the Society.

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUSTS ACT, 1950
SCHEDULE VIII VIDE RULE 17(1)

BALANCE SHEET FOR THE YEAR ENDED 31 *DECEMBER* 1981

FUNDS & LIABILITIES	Rs. P.	Rs. P.
Trust Fund or Corpus:		
Life Membership Fund (Individual):		
Balance as per last Balance Sheet	167334.03	
Add: Amount received during the year	37514.87	
Add: Donation received towards Life Membership Fund during the year	6072.08	210920.98
Corporate Life Membership Fund:		
Balance as per last Balance Sheet	34200.00	
Add: Amount received during the year	27550.00	61750.00
Vice Patron Fees:		
Amount received during the year		22500.00
Fixed Assets Fund:		
Balance as per last Balance Sheet	88828.73	
Less: Transferred from Income & Expenditure account on account of depreciation for the year	11857.77	76970.96
General Reserve Fund:		
Balance as per last Balance Sheet		37952.71
Building Fund:		
Balance as per last Balance Sheet		4697.68
Carried over		414792.33

ASSETS	Rs. P.	Rs. P.
Immovable Properties:		Nil
Investments:		
Government Securities (At cost):		
3% Conversion Loan 1946/86 of the face value of Rs. 25,000/-	25000.00	
5½% Govt. of India loan 2000 of the face value of Rs. 2000/-	2000.00	
In Units of the Face Value of:		
Rs. 200000/- of the Unit Trust of India (Cert. No. 01 82 0047)	200000.00	
In fiixed deposit with Maharashtra State Road Transport Corporation:	80000.00	307000.00
Motor Cars, Motor Cycle & Autocycle:		
Balance as per last Balance Sheet	2999.42	
Less: Depreciation during the year	599.87	2399.55
Furniture, Fixture & Equipment:		
Balance as per last Balance Sheet	81491.00	
Add: Purchase during the year	8572.24	
	90063.24	
Less: Depreciation during the year	11257.90	78805.34
Carried over		388204.89

FUNDS & LIABILITIES		
Brought over		414792.33
Publication Fund:		
Balance as per last Balance Sheet	96578.87	
Add: Amount received during the year	6500.00	
Add: Sale proceeds of Glimpses of Nature Booklets published under WWF/Volkart Foundation grant for the year	1142.04	104220.91
Other Earmarked Funds:		
As per Schedule 'A'		3602752.97
Staff Gratuity Fund:		
Balance as per last Balance Sheet	80000.00	
Add: Interest received during the year	8000.00	
Add: Transferred from Income & Expenditure account for the year	50000.00	138000.00
Provision for Capital Losses:		
Balance as per last Balance Sheet	4528.38	
Add: Transferred from Income & Expenditure account for the year on account of profit made on the sale of Bonds of Ahmedabad Manufacturing & Calico Printing Co. Ltd., Ahmedabad	10496.85	15025.23
Provision for Depreciation on Investments:		
Balance as per last Balance Sheet		9266.10
Centenary Celebration Fund:		
Transferred from Income & Expenditure account for the year		100000.00
Carried over		4384057.54

ASSETS		
Brought over		388204.89
Loans (Unsecured considered good):		
To Employees		510.00
Advances (Unsecured considered good):		
To Employees	94295.60	
To Employees & others for travel expenses (recoverable)	14113.77	
To others	29398.36	
To Nature Education Scheme	8088.92	145896.65
Stocks:		
A) Publications as per inventory taken & certified by the Honorary Secretary	175630.08	
B) *Cost of publications under preparation*:		
1. Synopsis of the Birds of India & Pakistan	736.90	
2. Encyclopedia of Indian Natural History	13906.20	190273.18
Income Outstanding:		
Interest accrued	48668.21	
Supplies & services	107801.70	
Grant Govt. of Maharashtra for 1981-82	109102.80	
Grant Govt. of India, Dept. of Science & Technology for 1981-82	30000.00	295572.71
Income Tax Refundable:		2355.40
Carried over		1022812.83

FUNDS & LIABILITIES		
Brought over		4384057.54
Liabilities:		
For expenses	173691.62	
For Sundry Credit Balances	35766.51	
For Library Deposits	600.00	210058.13
Income & Expenditure Account:		
Balance as per last Balance Sheet	21.27	
Add: Assets of income over expenditure transferred from Income & Expenditure Account for the year	1350.92	1372.19
Carried over		4595487.86

ASSETS		
Brought over		1022812.83
Cash & Bank Balances:		
A) *In Current Account with*:		
1. Grindlays Bank Ltd. M. G. Road, Bombay 400 023	115046.66	
2. Grindlays Bank Ltd. London (£ 1849.95) @ 17.45 per £	32281.62	
3. Chartered Bank, Bombay	229759.01	
In Savings Account with:		
1. Grindlays Bank Ltd. M. G. Road, Bombay 400 023	33311.63	
2. Bank of India, (Museum Savings Branch), Bombay	48705.14	
3. Bank of Baroda, University Branch, Bombay 400 023	344036.24	
4. Corporation Bank, Dalal Street, Bombay 400 023	1050534.73	
B) *In Fixed Deposit with*:		
1. Bank of India, Bombay (consisting of Rs. 36000/- of Salim Ali/Loke Wan Tho Ornithological Research Fund and Rs. 3000/- for Col. Burton's Nature Conservation Fund)	39000.00	
2. Chartered Bank, Bombay	400000.00	
3. Bank of Baroda, Bombay	200000.00	
4. Grindlays Bank Ltd. Bombay (including Rs. 37590/- of Charles McCann Vertebrate Zoology Field Work Fund)	205000.00	
Carried over	2697675.03	1022812.83

FUNDS & LIABILITIES		ASSETS		
Brought over	4595487.86	Brought over		1022812.83
		Cash & Bank Balances (contd.):		
		Brought over	2697675.03	
		In Fixed Deposit with:		
		5. Corporation Bank, Bombay (including Rs. 40000/- Sir Pirojsha Godrej Foundation Fund & Rs. 141260/- of Salim Ali/Loke Wan Tho Ornithological Research Fund)	200000.00	
		6. In Monthly Certificate with Bank of India, Bombay (consisting of Rs. 581124/- of Salim Ali Nature Conservation Fund & Rs. 93876/- of Salim Ali/Loke Wan Tho Ornithological Research Fund)	675000.00	3572675.03
Total	4595487.86	Total		4595487.86

Sd/- Salim Ali,
President,
Bombay Natural History Society

Sd/- A. N. D. Nanavati,
Honorary Secretary,
Bombay Natural History Society

Sd/- C. V. Kulkarni,
Honorary Treasurer,
Bombay Natural History Society

As per our report of even date
Habib & Co.,
Chartered Accountants.

Bombay, 15*th October*, 1982.

SCHEDULE 'A'

BOMBAY NATURAL HISTORY SOCIETY
SCHEDULE FORMING THE PART OF BALANCE SHEET AS AT 31ST DECEMBER 1981

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amount received during the year* (3)	*Interest earned during the year* (4)	*Transfers from other Funds* (5)	*Total of columns 2, 3, 4 & 5* (6)	*Spent during the year* (7)	*Refunds/ Adjust-ments* (8)	*Total of columns 7 & 8* (9)	*Balance as at 31st December 1981 (6 minus 9)* (10)
(1) Field Work Fund (Sir Dorabji Tata Trust)	3089.14	—	—	—	3089.14	3089.14	—	3089.14	—
(2) Staff Welfare Fund	11244.33	10000.00	1124.45	—	22368.78	—	—	—	22368.78
(3) Sálim Ali/Loke Wan Tho Ornithological Research Fund	221136.52	50000.00	—	—	271136.52	—	—	—	271136.52
(4) Col. Burton's Nature Conservation Fund	3820.94	—	300.00	—	4120.94	21.00	—	21.00	4099.94
(5) Charles McCann Vertebrate Zoology Field Work Fund	33533.35	775.00 (234.50) *	3353.33	—	37896.18	305.40	—	305.40	37590.78
(6) Sálim Ali Nature Conservation Fund	393751.66	192373.14	—	—	586124.80	—	5000.00	5000.00	581124.80
(7) Sálim Ali Nature Conservation Fund for Silent Valley Campaign expenses	—	5000.00	—	5000.00	10000.00	2118.48	2294.27 (BNHS)	4412.75	5587.25
(8) Col. A. C. Moore Conservation Fund	5269.00	—	—	—	5269.00	—	—	—	5269.00
(9) Field Work Fund under Pirojsha Godrej Foundation	40000.00	—	—	—	40000.00	—	—	—	40000.00
(10) Hospitality Fund (Dr. Sálim Ali)	—	1000.00	—	—	1000.00	—	—	—	1000.00
(11) Projector Fund received from members	968.04	—	—	—	968.04	—	—	—	968.04
(12) Scholarship Fund under Sálim Ali/Loke Wan Tho Ornithological Research Fund Investment	11050.45	—	22343.00	—	33393.45	12945.40	—	12945.40	20448.05
(13) Conservation Fund under Sálim Ali Nature Conservation Fund Investment	8230.11	—	47092.00	—	55322.11	44615.02	—	44615.02	10707.09
(14) Field Work Fund Under Pirojsha Godrej Foundation Fund Investment	1899.54	—	4000.00	—	5899.54	1043.56	—	1043.56	4855.98
Carried over ..	733993.08	259382.64	78212.78	5000.00	1076588.50	64138.00	7294.27	71432.27	1005156.23

Name of the Fund/Grant (1)	*Balance as per last Balance Sheet* (2)	*Additions/ Amount received during the year* (3)	*Interest earned during the year* (4)	*Transfers from other Funds* (5)	*Total of columns 2, 3, 4 & 5* (6)	*Spent during the year* (7)	*Refunds/ Adjust-ments* (8)	*Total of columns 7 & 8* (9)	*Balance as at 31st December 1981 (6 minus 9)* (10)
Brought over ..	733993.08	259382.64	78212.78	5000.00	1076588.50	64138.00	7294.27	71432.27	1005156.23
(15) *Grant Govt. of Maharashtra*: ..									
(a) Grant for 1979-80 for Establishment & Bldg. maintenance	517.52	—	—	—	517.52	—	517.52	517.52	—
(b) Grant for 1980-81 for Establishment & Bldg. maintenance	36351.08	—	—	—	36351.08	28672.94	7678.14	36351.08	—
(c) Grant for 1981-82 for Establishment & Bldg. maintenance	—	105102.80	—	—	105102.80	81363.39	—	81363.39	23739.41
(d) Grant for 1980-81 contd. 1981-82 for Building repairs	249034.96	—	—	—	249034.96	159663.60	—	159663.60	89371.36
(16) *Grant Govt. of India, Department of Science & Technology*:									
(a) Grant for 1980-81 contd. 1981-82 for building repairs	200000.00	—	—	—	200000.00	—	—	—	200000.00
(b) Grant for 1980-81 contd. 1981-82 for Computer Analysing of Bird Banding Data	42522.31	—	—	—	42522.31	28608.75	—	28608.75	13913.56
(c) Grant for 1977-78 contd. 1978-79, 1979-80, 1980-81 & 1981-82 for the publication of Some Beautiful Indian Climbers & Shrubs	35716.34	—	—	—	35716.34	—	—	—	35716.34
(d) Grant for 1981-82 for the publication of Encyclopedia of Indian Natural History	—	6000.00	—	—	6000.00	2708.05	3291.95 (BNHS)	6000.00	—
Carried over ..	1298135.29	370485.44	78212.78	5000.00	1751833.51	365154.73	18781.88	383936.61	1367896.90

Name of the Fund/Grant (1)	Balance as per last Balance Sheet (2)	Additions/ Amount received during the year (3)	Interest earned during the year (4)	Transfers from other Funds (5)	Total of columns 2, 3, 4 & 5 (6)	Spent during the year (7)	Refunds/ Adjustments (8)	Total of columns 7 & 8 (9)	Balance as at 31st December 1981 (6 minus 9) (10)
Carried over ..	1298135.29	370485.44	78212.78	5000.00	1751833.51	365154.73	18781.88	383936.61	1367896.90
(17) Grant Govt. of India, Ministry of Defence, Aeronautical Res. & Dev. Board for An Ecological Study of Bird Hazards at Indian Aerodromes	122222.95	1231433.00	—	—	1353655.95	206267.69	—	206267.69	1147388.26
(18) *Grants from US Dept. of the Interior Fish & Wildlife Service-National Park*:									
(1) Studies on the movement & population structure of Indian Avifauna	125234.18	452290.00	—	—	577524.18	509293.59	—	509293.59	68230.59
(2) Hydrobiological (Ecological) Research Station at Keoladeo Ghana Sanctuary, Bharatpur	544912.60	389700.00	—	—	934612.60	198686.32	—	198686.32	735926.28
(3) Study of ecology of certain endangered species of wildlife & their habitats	—	577500.00	—	—	577500.00	310702.06	—	310702.06	266797.94
(19) Grant from Tamil Nadu Salt Corpn. Ltd., Madras, for the study of ecological reconnaissance of Vedaranyam Swamp	12652.83	—	—	—	12652.83	12652.83	—	12652.83	—
(20) Grant from Chief Wildlife Warden, Chandigarh, Punjab for Bird Ringing Project	—	16513.00	—	—	16513.00	—	—	—	16513.00
Total rupees	2103157.85	3037921.44	78212.78	5000.00	5224292.07	1602757.22	18781.88	1621539.10	3602752.97

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* Sale proceeds of Checklist of the Birds of Maharashtra.

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUSTS ACT 1950

SCHEDULE IX [VIDE RULE 17(1)]

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST DECEMBER 1981

EXPENDITURE		
To *Expenses in respect of Properties*:		
Rates, Taxes and Cesses/Repairs & Maintenance: Met out of Grant Govt. of Maharashtra for 1980-81 contd. 1981-82	159663.60	159663.60
,, *Building Maintenance Expenses*:		
(As per contra) from Govt. of Maharashtra grant for 1980-81	2112.94	
for 1981-82	8800.34	10913.28
,, *Establishment Expenses*:		
Salaries including D.A. etc. (As per contra) from Govt. of Maharashtra grant for 1980-81	26560.00	
for 1981-82	72563.05	
Salaries including D.A. etc. (Other than above)	228697.64	
Society's contribution to Staff Provident Fund	11842.00	
Postages	5604.45	
Printing & Stationery	13340.57	
Advertisement	787.05	
Telephone Rental & Call charges	3081.00	
Bank Charges	1493.90	
Meeting expenses including talks, film shows etc.	3750.75	
Conveyance & travelling expenses (local & up-country)	4491.22	
Motor car maintenance expenses	610.00	
Medical expenses for staff members	5111.00	377932.63
Carried over		548509.51

INCOME		
By *Rent*: (Accrued & Realised)		
,, *Interest* (Accrued & Realised):		
On Securities	2920.16	
On Fixed Deposits	152670.99	
Add: Refund of Income Tax	2184.00	157775.15
,, *Donations general in cash*:		3050.97
,, *Donations towards specific purpose*:		
Charles McCann Vertebrate Zoology Field Work Fund	775.00	
Salim Ali Nature Conservation Fund	192373.14	
Salim Ali Nature Conservation Fund for Silent Valley Campaign Expenses	5000.00	
Hospitality Fund from Dr. Salim Ali	1000.00	
Publication Fund	6500.00	
Salim Ali Ornithological Research Fund from Dorabji Tata Trust	50000.00	
Life Membership Fund	6072.08	261720.22
,, *Grants*:		
a) *Govt. of Maharashtra*:		
1. For 1981-82 Establishment & Building Maintenance	105102.80	
2. For 1981-82 Educational Activity	4000.00	
Carried over	109102.80	422546.34

EXPENDITURE		
Brought over		548509.51
To *Audit Fees*:		1000.00
,, *Amount written off*:		
Bad Debts		1306.79
,, *Miscellaneous Expenses*:		
General charges	4268.60	
Insurance Premium	243.00	
Repairs to Furniture & Equipment	6618.76	
Printing Society's Prospectus	702.00	
Loss on foreign exchange due to fluctuation in exchange rates	626.01	12458.37
,, *Depreciation*:		
On Furniture & Equipment	11257.90	
On Motor Cars, Motor Cycle & Auto Cycle	599.87	11857.77
,, *Amounts transferred to Reserve or Specific Funds*:		
Grants transferred to relevant funds	2778538.80	
Donations towards specific funds transferred to relevant account in the Balance Sheet	255648.14	
Life Membership Fees transferred to Life Members Fund in the Balance Sheet	37514.87	
Corporate Life Membership Fees transferred to Corporate Life Membership Fund in the Balance Sheet	27550.00	
Life Membership Donation transferred to Life Membership Fund in Balance Sheet	6072.08	
Carried over	3105323.89	575132.44

INCOME		
Brought over		422546.34
By *Grants* (contd.):		
Brought over	109102.80	
b) *Govt. of India*		
Department of Science & Technology for 1981-82 Journal printing expenses	30000.00	
For 1981-82 Encyclopedia of Indian Natural History publication	6000.00	
c) Indian National Science Academy for 1981-82 Journal printing expenses	5000.00	
d) Govt. of India, Ministry of Defence, Aeronautical Research & Development Board for 1981-82: An Ecological Study of Bird Hazards at Indian Aerodromes	1231433.00	
e) Chief Wildlife Warden, Punjab, Chandigarh, for 1981-82 Bird Ringing Project	16513.00	
f) US Dept. of Interior, Fish & Wildlife Service-National Park Service:		
1) For Studies on Movement & Population Structure of Indian Avifauna	452290.00	
2) For Hydrobiological (Ecological) Res. Station at Keoladeo Ghana Bird Sanctuary, Bharatpur	389700.00	
3) For the Ecological Study of Certain Endangered Species of Wildlife & their habitats	577500.00	
Carried over	2817538.80	422546.34

EXPENDITURE		
Brought over		575132.44
To *Amounts transferred to Reserve or specific funds*: (contd.)		
Brought over	3105323.89	
Vice Patron Fees transferred to relevant fund in the Balance Sheet	22500.00	
Sale proceeds of Glimpses of Nature Booklet to Publication Fund	1142.04	
Sale proceeds of Checklist of the Birds of Maharashtra transferred to Charles McCann Vertebrate Zoology Field Work Fund	234.50	
Interest on Fixed Deposits transferred to respective funds	86212.78	
Profit on sale of investment transferred to provision for capital losses account	10496.85	3225910.06
,, *Provisions*:		
For Staff Gratuity	50000.00	
For Centenary Celebrations expenses	100000.00	
For Staff Welfare amenities	10000.00	160000.00
,, *Expenses on objects of the Trust*:		
Educational: from respective funds (as per contra)		
1. Expenses towards research scholarships & other expenses on Ornithological Research out of Scholarship Fund under Salim Ali/Loke Wan Tho Ornithological Research Fund Investment	12945.40	
2. Expenses on Bird Data Computer Analysis Study out of grant Govt. of India, Dept. of Science & Technology 1980-81 contd. 1981-82	28608.75	
Carried over	41554.15	3961042.50

INCOME		
Brought over		422546.34
By *Grants*: (contd.)		
Brought over	2817538.80	
g) Life Membership fees: (individual)	37514.87	
h) Corporate Life Membership fees	27550.00	
i) Vice Patron Fees	22500.00	2905103.67
,, *Income from Subscriptions & Entrance frees*:		
Membership subscriptions	72326.18	
Corporate membership subscriptions	20570.94	
Student membership subscriptions	2345.00	
Forest Department Nominees	250.00	
Subscriptions to Journal (non-members)	22438.25	
Entrance fees	11535.00	129465.37
,, *Income from Publications*:		
Journal sales	2807.50	
Glimpses of Nature Booklet	1142.04	
Checklist of Birds of Maharashtra	234.50	4184.04
,, *Surplus on Sale of Books*:		
Book of Indian Birds	49457.00	
Book of Indian Animals	38002.00	
Some Beautiful Indian Trees	3762.00	
Identification of Poisonous Snakes Chart	110.00	
A Bundle of Feathers	10139.77	
Carried over	101470.77	3461299.42

EXPENDITURE			
Brought over			3961042.50
To *Expenses on objects of the Trust*: (contd.)			
Brought over		41554.15	
3. Expenses on Encyclopedia of Indian Natural History publication spent out of grant Govt. of India, Dept. of Science & Technology 1981-82			
Total expenditure	16614.25		
Less: met by BNHS	13906.20	2708.05	
4. Expenses relating to:			
a) Publication of Hornbill Newsletter	20000.00		
b) Research expedition of Sri Lanka	8652.00		
c) Grant to Research Projects	8100.00		
d) Paid for a Slide Projector donted to Wildlife Preservation Society, Nawegaon	1158.30		
e) Travel expenses for Dr. Salim Ali & Krishna Raju	2760.50		
f) Postage & other expenses	5104.22		
	45775.02		
Less: Amount received for slide projector from Dr. Salim Ali & Mrs. D. S. Variava	1160.00		
Met out of interest from Sálim Ali Nature Conservation Fund Investment		44615.02	
Carried over		88877.22	3961042.50

INCOME			
Brought over			3461299.42
By *Surplus on Sale of Books*: (contd.)			
Brought over	101470.77		
Checklist of Borivli National Park	2799.00		
Other publications	4409.68		
Nature Calendars	34320.18		
	142999.63		
Add: Surplus on packing charges	115.51		143115.14
„ *Profit on Sale of Investments*: Sale of 50 8% convertible & 202 8% redeemable bonds of Ahmedabad Mfg. & Calico Printing Co. Ltd., Ahmedabad			10496.85
„ *Miscellaneous Income*:			
1) Fee for the use of Society's transparencies	700.00		
2) Library fines	83.50		
3) Other receipts including Society's share of Snake Exhibition receipts	102534.18		103317.68
„ *Administrative Fees*: For handling various funds during the year debited to respective funds			127570.54
„ *Transfer to specific Funds*: Depreciation of fixed assets transferred to Fixed Assets Fund (as per contra)	11857.77		
Carried over	11857.77		3845799.63

Expenditure		
Brought over		3961042.50
To *Expenses on Objects of the Trust*: (contd.)		
Brought over	88877.22	
5. Expenses for field research under interest on Sir Pirojsha Godrej Foundation Fund Investment	1043.56	
6. Expenses under Charles McCann Vertebrate Zoology Feld Work Fund	305.40	
7. Expenses on Field Studies under Dorabji Tata Field Work Fund	3089.14	
8. Expenses on Silent Valley Campaign met out of Salim Ali Nature Conservation Fund for Silent Valley Campaign	2118.48	
9. An Ecological Study of Bird Hazards at Indian Aerodromes met out of grant received from Aeronautical Research & Development Board, Govt. of India, Ministry of Defence	206267.69	
10. Studies on the Movement & Population Structure of Indian Avifauna met out of grant from US Department of the Interior, Fish & Wildlife Service-National Park Service	509293.59	
11. Hydrobiological (Ecological) Research Station at Keoladeo Ghana Sanctuary, Bharatpur, met out of grant from US Department of the Interior, Fish & Wildlife Service-National Park Service	198686.32	
12. Expenses for the Study of Ecology of Certain Endangered Species of Wildlife & Their Habitats met out of grant from US Dept. of the Interior, Fish & Wildlife Service-National Park Service	310702.06	
Carried over	1320383.46	3961042.50

Income		
Brought over		3845799.63
By *Transfer to specific Funds*: (contd.)		
Brought over	11857.77	
Expenses on Establishment & Building Maintenance transferred to Govt. of Maharashtra Grant (as per contra) for 1980-81	28672.94	
for 1981-82	81363.39	
Expenses on Building Repairs transferred to Govt. of Maharashtra grant 1980-81 contd. 1981-82 (as per contra)	159663.60	
,, *Expenses on specific Objects Transferred to Relevant Funds*:		
Grants as per contra	1333057.29	1614614.99
		[illegible]
Carried over		5460414.62

EXPENDITURE				INCOME	
Brought over			3961042.50	Brought over	5460414.62
To *Expenses on Objects of the Trust*: (contd.)					
Brought over		1320383.46			
13. Expenses under Col. Burton's Nature Conservation Fund		21.00			
14. Expenses for Ecological Reconnaissance of Vedaranyam Swamp met out of grant from Tamil Nadu Salt Corpn. Ltd. 1980-81 contd. 1981-82		12652.83	1333057.29		
,, *Journal Expenses*:					
1) For publishing the Journal of the Society		144016.24			
2) Publishing Hornbill Newsletter Total cost	28577.55				
Less: met from the interest on Salim Ali Nature Conservation Fund Investment	20000.00	8577.55			
,, *Library Account*:					
1) Subscription to other Societies	11.34				
2) Purchase of Books	2960.95				
3) Book binding expenses	304.50	3276.79			
,, *Field study programme & other local field study expenses*:		4035.59			
,, *Maintenance of reference collection*:		5057.74	164963.91		
Excess of income over expenditure carried over to Balance Sheet			1350.92		
Total			5460414.62	Total	5460414.62

Sd/- SALIM ALI,
President,
Bombay Natural History Society

Sd/- A. N. D. NANAVATI,
Honorary Secretary,
Bombay Natural History Society

Sd/- C. V. KULKARNI,
Honorary Treasurer,
Bombay Natural History Society

As per our report of even date
HABIB & CO.,
Chartered Accountants.

BOMBAY, 15*th October*, 1982.

BOMBAY NATURAL HISTORY SOCIETY
NATURE EDUCATION SCHEME
RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31*ST DECEMBER*, 1981

RECEIPTS			PAYMENTS		
To *Balance as at* 1*st January* 1981:			,, By Refund of advance from Bombay Natural History Society		2289.08
With Grindlays Bank Ltd., Bombay on Current Account	3889.40		,, Salary Nature Education Organiser		14943.90
With Nature Education Organiser	200.00	4089.40	,, General charges		2755.30
			,, Postages		195.50
			,, Printing & stationery		854.25
,, *Grants*:			,, *Balance as at* 31*st December* 1981:		
Govt. of Maharashtra for the year 1980-81		16191.00	1. With Grindlays Bank Ltd., Bombay on Current Account	1331.05	
,, *Sale of Nature Study Booklets*:		199.76	2. Grindlays Bank Ltd., Bombay in Fixed Deposit	6000.00	
Advance from Bombay Natural History Society		8088.92	3. Cash on hand with Nature Education Organiser	200.00	7531.05
Total		28569.08	Total		28569.08

Sd/- SALIM ALI,
President,
Bombay Natural History Society

Sd/- A. N. D. NANAVATI,
Honorary Secretary,
Bombay Natural History Society

Sd/- C. V. KULKARNI,
Honorary Treasurer,
Bombay Natural History Society

As per our report of even date
HABIB & CO.,
Chartered Accountants.

BOMBAY, 15*th October*, 1982.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD AT BEST CONFERENCE HALL, COLABA, BOMBAY, ON MONDAY, THE 29TH NOVEMBER 1982, AT 6 P.M.

When the following were present:

1. Mr R. E. Hawkins (in the Chair)
2. Dr. P. J. Deoras
3. Dr. C. V. Kulkarni
4. Dr. Sálim Ali
5. Dr. A.N.D. Nanavati
6. Mr. S. D. Bhaumik
7. Mr. N. D. Mulla
8. Mr M. K. Mistry
9. Mr. M. D. Agharkar
10. Mr. H. K. Divekar
11. Mrs. P. Mukherjee
12. Mr. Humayun Abdulali
13. Mr. J. C. Daniel
14. Mr. V. K. Paralkar
15. Mr. Ashraf I. Macchiwalla
16. Mr. J. P. Irani
17. Mr Bansi Mehta
18. Mr. D. J. Panday
19. Mr. S. R. Nayak
20. Mr. K. N. Naoroji
21. Mr. S. G. Monga
22. Mr. R. Naoroji
23. Mr. Anil Dave
24. Mr. G. L. Kalro
25. Mr. Parvish Pandya
26. Mr. Ulhas Rane
27. Mr. Bittu Sahgal
28. Sanctuary Magazine
29. Mr. R. S. Moral
30. Mr. S. Mistry
31. Mr. Oswald Thayil
32. Miss Meena Haribal
33. Mr. M. R. Patel
34. Mr. G. R. Rege
35. Mr. F. A. Thakur
36. Miss Usha Ganguli
37. Mr. D. N. Goenka
38. Mr. Ramani N. M.
39. Mr. Suresh Bhatkal
40. Mr. Sam J. Bhacka
41. Mr. A. G. Puranik
42. Mr. K. S. Khambad Kone
43. Mr. M. Bharucha
44. Mr. Chandragupta Bhogilal Mehta
45. Mr. Dhun Mehta
46. Mr. Dilip Patil
47. Mr. D. P. Bannerjee
48. Mr. Hilla Mewavala
49. Mr. K. K. Vajifdar
50. Miss S. S. Driver
51. Mr. J. H. Thakkar
52. Mr. Chandrakant Wakankar

Dr Sálim Ali, President of the Society, proposed that Mr R. E. Hawkins take the Chair and conduct the proceedings of the Meeting. This was seconded by Mr. D. J. Panday.

1. The Chairman suggested that as the Honorary Secretary's main report had been previously circulated it was unnecessary to read it but questions could be raised about it after the Honorary Secretary's Supplementary Report. There was no objection to this suggestion.

2. Dr C. V. Kulkarni, the Honorary Treasurer, summarized the salient points of the accounts for the period covered by the meeting. Fortunately, he said, there is a surplus of Rs. 1350/-, after setting aside Rs. 38,000/- for enhanced salaries and dearness allowance,

Rs. 5000/- for medical assistance to the staff, Rs. 1,00,000/- for Centenary celebrations, Rs. 50,000/- for staff gratuity fund, and Rs. 10,000/- for the staff welfare fund. This surplus had been generated through various donations and overhead charges received from the projects which were being handled by the Society.

No questions were raised on the accounts, and the Chairman declared the Balance Sheet and Statement of Accounts for 1981 accepted.

3. Dr C. V. Kulkarni, the Honorary Treasurer, proposed that Messrs Habib & Co., the present auditors of the Society be reappointed on the same remuneration as before. This was seconded by Mr D. J. Panday and was accepted.

4. In his Supplementary Report for the period since January 1982 the Honorary Secretary stated that for the Avifauna Project an additional bird-ringing camp had been arranged at Harike in the Punjab and later would be additional camps in the Siwaliks, Nilgiris and other areas. For these we would welcome assistance from competent ornithologists and a notice to this effect would be circulated to members seeking their assistance.

In the Hydrobiology Project problems in regard to arranging accommodation and laboratory premises for the staff had arisen, as the old Palace quarters used for this purpose were now required for other purposes by the owner. These problems are being solved. Laboratory has been established and data collection is in progress in Bharatpur.

For the Endangered Species Project, the Honorary Secretary stated that two permanent study camps for conducting studies on the Great Indian Bustard have been opened — one at Solapur, Maharashtra, and the other at Karera, Madhya Pradesh. A preliminary survey of the Lesser Florican's habitat has been initiated. On the status and populations of elephants a preliminary survey is being conducted in Chilla Sanctuary in Uttar Pradesh in addition to other areas, where work is in progress already.

As regards publications, he said that the second edition of S. D. Ripley's A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN, the second edition of N. L. Bor & M. B. Raizada's SOME BEAUTIFUL INDIAN CLIMBERS AND SHRUBS, and T. & P. Hodd's GRASSES OF WESTERN INDIA had been published. THE BOOK OF INDIAN REPTILES, by J. C. Daniel, is now in the press and is expected to be available in 1983. A selection of articles published in the Society's *Journal* over the years, under the title of A CENTURY OF NATURAL HISTORY is hoped to be ready well before the Centenary celebrations commence. However, the ENCYCLOPEDIA OF INDIAN NATURAL HISTORY, a second Centenary publication, may be delayed as some contributions are still outstanding. The Honorary Secretary also reported that the Society is concerned with the reproduction of coloured plates by John Henry Dick for a bird book to be published by the Oxford University Press.

The Honorary Secretary reported that he was in negotiation with the Maharashtra State Government for a piece of land suitable for the Society's proposed Institute. A proposal for the Institute had been sent to the Department of Environment in accordance with the decision taken at the Extraordinary General Body meeting held on 29th September 1982.

He explained that the Extraordinary General Body meeting planned for 29th October 1982 for amending the Society's constitution had had to be postponed as the day was (unexpectedly) declared a public holiday. He said the meeting would be convened on a date to be notified.

For the Centenary Celebrations, a Seminar will be held from 15th to 19th September 1983. The subject of the seminar is CONSERVATION IN DEVELOPING COUNTRIES. A number of proposals from people who would speak on this occasion have been received. As soon as a synopsis of their talks is received from the participants they will be refereed by experts, mostly referees of the *Journal*. The last day, i.e. 19th September, of the seminar would be devoted for a general discussion of the proceedings and formulation of goals and, where necessary, recommendations to be put up to the Government.

An exhibition of the activities of the Society, including the activities under the various Research Projects, will be held along with a Snake exhibition around Diwali or Dassera, a few weeks after the Seminar, to sustain interest in the Society.

A Photographic Exhibition of wildlife photographs from India and the neighbouring countries will be arranged. It is proposed to limit entries to not more than 5 photographs for an entrant. It is also proposed to publish the best photographs in a commemorative volume. Suggestions and donations for the two exhibitions were invited from members.

On conclusion of the Honorary Secretary's supplementary report the Chairman invited members to ask questions and make comments.

Dr P. J. Deoras made the following suggestions: (1) A special issue of the *Journal* should be published on the occasion of the Centenary Celebrations, with articles on a given theme.

(2) That the papers presented at the Seminar on Conservation in Developing Countries, should not be concerned exclusively with bird ecology, migration and other ornithological items but with Conservation in its wider and more general aspects.

(3) That a snake exhibition should be avoided because it results in killings snakes. The exhibition should concentrate on the collections at the Society. He was of the opinion that listing of the various taxa in the Society's collections, with their localities of collection, and comments on the status and details of collection, if published would be valuable for future workers. The exhibition should be designed to educate rather than to raise money. He desired that a committee be appointed to go into all these aspects, and exhorted the Committee to consider the opinion of the minority and not to go only by the opinion of the majority.

Dr Deoras also wanted to know whether the recovery of rings had first been statistically analysed before computerizing it.

Mrs. Phillippa Mukherjee then made her suggestions:

(1) She deplored the absence of Nature Education in the Secondary School Certificate syllabus, and exhorted the Society to take up the matter with the Government of Maharashtra with a view to correct this defect.

(2) While appreciating the excellent work done by the Society's Nature Education Organiser single-handedly Mrs Mukherjee said that funds ought to be found to expand the scheme, and extend it to a greater number of schools and institutions. She said the Rs. 3000/- or so now available for the Nature Education Scheme was ludicrously inadequate. She suggested a deputation should request the Educational authorities to change the Secondary School Certificate syllabus and introduce more natural history for the primary and secondary standards.

(3) She suggested that the Brains Trust sessions once held by the Society should be revived.

(4) She suggested that a larger Editorial Board should be constituted to assist the three Editors of the *Journal*.

(5) She suggested that much more attention should be paid to children's education. Exhibitions should be arranged for them and a Children's Corner organized in the *Hornbill*.

(6) She drew attention to the difficulties experienced by members and visitors to the Society is being directed to the right person to solve their problems. Mrs Mukherjee suggested that a person be appointed to attend to these needs efficiently.

Mr Humayun Abdulali then spoke:

(1) He deplored the poor cooperation he and his suggestions received from the Honorary Secretary and the Executive Committee. He said most of his letters did not reach the Executive Committee at all and were being either ignored or replied to by the Honorary Secretary.

(2) Mr Abdulali pointed out that an Advisory Committee has not yet been formed after the last elections, and the Society is without one at the time of the current Annual General Meeting.

(3) Mr Abdulali pointed out that though the late Dr C. D. Deshmukh was a member of the Society and served for quite some years on the Executive Committee of the Society, no condolence resolution had been passed by the Society's Executive Committee to mourn his death.

(4) Mr Abdulali pointed out that in spite of constant reminders indexes for nearly 15 volumes of the Society's *Journal* were not available up to now, the last being for Vol. 63.

(5) Mr Abdulali wanted to know the progress made in regard to computerizing of the bird ring recovery records.

(6) Mr Abdulali said that there had been a deliberate attempt at the Society to keep Mr G. V. Bedekar's letter of resignation as a Vice-President from the Executive Committee, and that it was only because of his own efforts that it had been brought to the Executive Committee for discussion.

(7) Mr Abdulali deplored the non-availability of staff in the office when necessity arises. The experienced staff is being sent to the Projects, and the newcomers are unable to attend specific demands made by the members.

(8) Mr Abdulali pointed out that he had been asked to select some articles for the A CENTURY OF NATURAL HISTORY, and had made some selections but had heard nothing more. He felt he was entitled to know what progress had been made.

(9) He asked for information about the papers received for the proposed Centenary Seminar.

(10) Mr Abdulali pointed out that there had been no notice of the current Annual General Meeting in the local papers. He said that whenever a meeting or a film show was arranged jointly by the Society and the World Wildlife Fund, the role of the latter was noticed in papers while the Society's role was left unnoticed.

(11) Mr Abdulali suggested that short biodata of candidates desiring to contest elections to the Society's Executive Committee should be circulated, and wished to propose a Resolution to this effect, but the Chairman ruled that the business of the meeting must be restricted to the Agenda and no resolutions could be considered.

(12) As an afterthought, Mr Abdulali referred to the resignation of Mr R. E. Hawkins as a Vice-President and alleged it was due to dissatisfaction with the conduct of the Society's affairs.

Mr M. D. Agharkar asked what progress had been made in our negotiations with the

Central Government regarding the proposed Institute of Ornithology.

In ersponse to the remarks on the death of Dr C. D. Deshmukh, the Chairman ruled that this meeting record our appreciation of his unfailing helpfulness to the Society and our regrets on his demise and directed the Honorary Secretary to convey our condolences to the family.

The Honorary Secretary replied as follows:

To Dr Deoras: He stated that certain of the suggestions made were already being acted on, and the rest would be seriously considered.

To Mrs Mukherjee: He agreed entirely with her remarks on the Nature Education curriculum and the entirely inadequate financial support for Nature Education activities of the Society. He would do his best to implement her suggestions with support from other members.

Mr Abdulali's remarks referred to letters which had already been answered, as in the case of computer analysis. A digest of the preliminary analysis had been supplied to him, and he had been informed that 300 sheets of computer printout were available for study if he so desired. Further work on these lines, which is expensive, has been delayed until some of the fresh data from the projects, which is more complete and comprehensive, is also recorded. The Society's Advisory Committee has been formed, and he would inform Mr Humayun Abdulali about the date of the meeting at which this was decided. The question of indexes has been discussed by the Executive Committee and decisions taken are being implemented. Regarding the staff going to the projects, he pointed out that we cannot deny our staff an opportunity to work on field projects, but whenever one of them was selected for project work, a replacement on the Government grant was appointed in his place. The new recruits were generally untrained and needed some time to learn the work. They could not be expected to answer queries as effectively as former workers who may have worked at the Society for years. There had been no attempt at suppression of Mr Abdulali's letters, but he was unable to place on the agenda letters in which facts were incorrectly stated.

The Honorary Secretary informed Mr Agharkar that the proposal for the Institute had been sent to the Department of Environment, but so far no response had been received from them.

Referring to the last remarks of Mr Abdulali, the Chairman said he had reached the age of 75, had been a Vice-Chairman of the Society for twelve years, and felt it was time for a change.

The meeting terminated with a vote of thanks to the Chair.

THE SOCIETY'S PUBLICATIONS

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The Book of Indian Animals, by S. H. Prater, 4th edition (reprint). 28 plates in colour by Paul Barruel and many other monochrome illustrations. Rs. 60.00
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The Book of Indian Reptiles By J. C. Daniel (*in press*)

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Miscellaneous

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A Century of Natural History Edited by J. C. Daniel (*in press*)

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